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PAPERS

IN

MECHANICS,

The SILVER MEDAL *was this Session voted to Captain* T. M. BAGNOLD, *of the Royal Marines, High Row, Knightsbridge, for his Invention of a Gun and Carriage, to clear the tops of the Enemy's Ships from Marksmen in close Action, The following Communication was received from him, an Explanatory Engraving is annexed, and a Model of the Gun and Carriage, are preserved in the Society's Repository.*

SIR,

I HAVE the honor to transmit you a model of a gun and carriage, invented by myself for the purpose of protecting our naval officers, from the enemy's marksmen in close action, and a paper, descriptive of it, which I beg the favor of you to lay before the Society, and which, considering the end proposed, I trust they will deem not altogether undeserving their notice.

The melancholy loss sustained by the navy, by the death of Lord Nelson, who fell by a marksman in the enemy's top, first suggested to me an idea of a carriage, which, by scouring the tops of an enemy in close action, would greatly diminish the loss among our officers and men quartered on the upper deck, and greatly injure the enemy's running-rigging, in a part where many material ropes are of necessity collected.

I am, Sir,
Your obedient humble servant,
T. M. BAGNOLD.

[illegible], *High Row, Knightsbridge,*
March 12*th*, 1811.

To C. Taylor, M. D. Sec.

Description.

The lower part of the model is made to represent part of the deck of a ship of war, either gangway, poop, forecastle, or quarter deck, on which the carriage traverses round a bolt, which passes through a beam and forelocks in the carriage. As the hole through the beam for the bolt might weaken it, it might be passed through a piece of elm or oak between two beams, and thus rather strengthen than weaken the frame.

The construction of the carriage will explain itself.

The gun is elevated by a rack and pinion, and may be retained

Pl. IV.

Captain T. M. Bagnold's Improved Gun and Carriage.

Fig. 1.

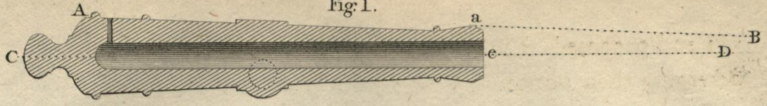


Fig. 2.

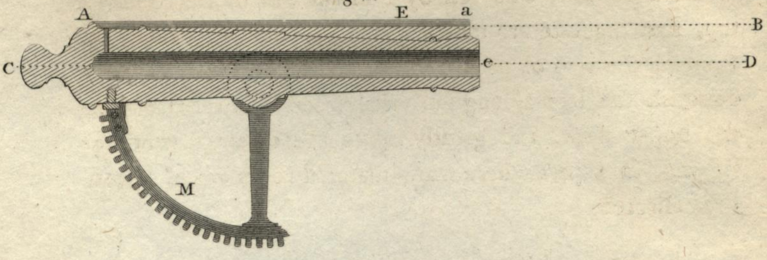
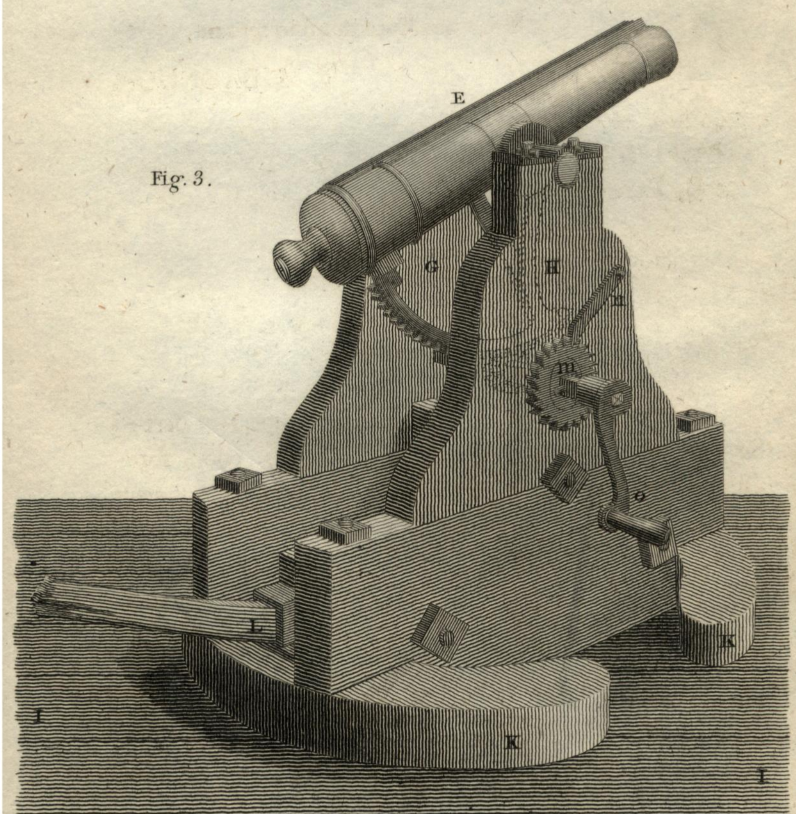


Fig. 3.



Drawn by J. Farey. *Engraved by S. Porter.*

retained in any position by the tooth-wheel, and catch on the right cheek of the carriage.

Firing in the navy is rendered *uncertain* and *incorrect*, by the roll of the vessel altering the elevation; and as it is impossible for the seamen to keep his eye for the elevating sight, and directing one at the same time, I have endeavoured to remedy the defect, by placing a bar of brass on the top of the gun, which, by correcting the difference of diameters at the muzzle and breech, renders the lines of flight and sight parallel to each other at one view, and therefore reduces the necessity of two sights to one, and enables the seaman to keep his eye on his object till the moment he fires, in this instance particularly necessary; on the upper surface is a groove, similar to that on a double fowling-piece, which renders the aim of the gunner, at the short distance this gun will ever be wanted for, an absolute and rifle-like certainty.

Mode of Firing.

In firing a common long nine-pounder, eight men are usually required; whereas, two men and a boy are sufficient for this gun. One points, primes, fires, and stops the vent; the other sponges, loads and winds up; the boy supplies ammunition. The man who fires, directs the gun by the handspike, and keeping his eye along the sight, orders the man who winds the gun up when to stop, and fires directly at his object, by means of the lock string; and as the gun has no recoil, the marksman safely keeps his eye to it till he fires, and with a little experience may strike a small object with the greatest certainty.

It may be objected, that the carriage could not stand the explosion without being allowed a recoil.

I answer, when this gun is used, it will be at *very close quarters*, and at a *very great elevation*, at 60″ or 70″; consequently the recoil is nearly downwards, and as cannister shot will be the best on these occasions, from four to eight ounces of powder will be a very full charge for one hundred and forty musket balls; more would only scatter them, and spoil the effect, particularly as one hundred yards is the greatest distance it will be ever wanted; for if the gun should be bored with a chamber, on the carronade principle, less would do, as in those guns, from one-twelfth to one-sixteenth of gunpowder, in proportion to the weight of the shot, is all the powder allowed for long ranges. And by lining round the head of the carriage with strong plates of iron, which passing under the arm of the gun, should be bolted together through all; the carriage would be rendered sufficiently strong to bear any explosion whatever. I tried the experiment on a brass twelve-pounder, in a frame work carriage, and found a satisfactory result, and saw, in the lines off Flushing, two brass twenty-four pounders on a construction something similar. Should brass be objected to on the score of œconomy, I answer, iron would do as well, and a short gun as well or better than a long one. As the carriage is put together with screw bolts, it may, in case of necessity, be taken to pieces and put below.

T. M. BAGNOLD,
Captain Royal Marines.

Reference

Reference to the Drawings of Captain T. M. Bagnold's improved Gun and Carriage. Plate 4. Fig. 1, 2, and 3.

Figs. 1 and 2 of this plate shew the difference of the common ship's gun, with the improvements before us; in fig. 1, which is the common gun, the line C D is the axis or central line of the caliber of the gun; and A B is the line of sight by which it is pointed; this line, which touches the largest part of the breech at A, and the muzzle at *a*, is not parallel to the line C D, which is the flight of the shot, because of the greater thickness of the gun at its breech; this obliges the gunner to employ two lines of sight; the one A B, which is on the top of the gun, he uses to point the gun in its horizontal direction; and another line by the side of the gun, and therefore in the same plane as C *c*, he uses to give it the proper elevation. To avoid the necessity of thus recurring to two sights, Captain Bagnold has applied a brass bar E, figs. 2 and 3, upon the top of the gun having a groove along it, which is exactly parallel to the line of flight, as shewn by the dotted lines, (to which the same letters apply as for fig. 1,) and being also parallel to it in the horizontal direction, it serves to point the gun at one observation.

Fig. 3 explains the construction of a carriage for this gun, G H are the two cheeks made of very strong plank, and united by cross pieces and strong bolts; the lowest of these pieces, which is in the centre of the frame, has a hole through it, to receive a very strong iron bolt which is fastened into the deck, I I; and upon this bolt the gun and carriage traverses horizontally; K K are two curved pieces of timber fastened to the cheeks G H; these resting upon the deck, cause the carriage to stand firmly; it is turned about by the handspike L, to direct the gun horizontally; to give it the requisite elevation, a quadrant M, fig. 2, is fixed to the two trunnions and the breech of the gun; and having teeth on its circumference, is moved by a pinion (shewn dotted in fig. 3,) fixed on an axis, passing through the two cheeks of the frame; on the end of this, a ratchet wheel *m* is fixed, and a click *n* holds it up: the pinion is turned round by a winch *o*, which affords the means of elevating the gun with the greatest ease and accuracy, to point to any object by the sight E; the carriage must be framed with the greatest strength to resist the recoil of the gun, which will act much more powerfully upon this than the common gun-carriage, because it cannot run back when fired.

The following Certificates were produced.

From ADMIRAL E. HARVEY, stating that he had examined Captain Bagnold's model of a gun and carriage, and that a gun for this purpose is a desideratum in the service, particularly when the marksman can fire without previously moving from his aim, and thereby avoid the uncertainty that would otherwise result from the motion of the two vessels.

From ADMIRAL Sir ROGER CURTIS, stating that he had inspected Captain Bagnold's model, and is of opinion that if the gun and carriage is made transportable, for being fired from various situations as may be found necessary, that a gun so mounted would in close action be very useful for the purpose for which it is intended; and that several Naval Officers to whom he had shewn it expressed the same opinion.

From COMMODORE I. ROWLEY, stating that he had examined the drawing and model of Captain Bagnold's gun, for dislodging marksmen from the enemy's tops in close action, and had shewn them to several of his brother officers, who agreed with him in opinion of it being likely to answer that intention; and that the proposed object is no doubt of considerable importance in an engagement at sea.

From CAPTAINS Sir ROBERT LAURIE, W. M. COURTENAY, KEITH MAXWELL, JOHN RICHARD LUMLEY, and M. HEAD, all of the Royal Navy, stating that they had examined the model of the gun and carriage, invented by Captain Bagnold, for clearing the enemy's tops of marksmen in a close action, and are of opinion that it is well calculated for that purpose, would be highly beneficial in its effects, and appears to them better constructed to answer its end with precision, then any thing of the kind yet invented.

From LIEUTENANT CHARLES HOPE SMALL, of the Royal Artillery, stating that he had examined the model of a gun and carriage, invented by Captain Bagnold, for the purpose of dislodging marksmen from the enemy's tops in close action. That as the elevation in this case must be great, and the distance small, the charge of powder for carrying grape or cannister shot will be very trifling, and that having had some experience in his Majesty's Navy, he is of opinion the gun is well calculated to produce the intended effect.

The Silver Medal *was this Session voted to Mr.* William Brunton, *of Butterley Iron Works, in Derbyshire, for an Improved Pump, for raising the Water whilst Wells are sinking or making. The following Communication was received from him, an Explanatory Engraving is annexed, and a Drawing of the Machine is preserved in the Society's Repository.*

SIR,

I beg leave through you, to lay before the Society for the Encouragement of Arts, Manufactures and Commerce, drawings of a pump upon an improved construction, for the purpose of raising water from pits, whilst they are sinking. Before I enter upon an explanation of my plan, it will be requisite to state those inconveniences arising from the common mode, which are intended to be obviated.

First, as it is necessary for the pumps whilst sinking, to be always working upon air, that the water may be kept very low in the pit, the engine of course frequently goes too fast, and carries up by the violence of the current small pieces of stone, coal, or other substances, and lodges them above the bucket, which must considerably retard the working of the pump, and wear the leather.

Secondly.—When the engine is set to work, (after having been stopped whilst working upon air, and consequently a quantity of air remaining in the suction-pipe, with the small stones, &c. deposited on the valves of the bucket,) it often happens that the compressure of the air by the descent of the bucket, is not sufficient to overcome the weight of the bucket valves so loaded with rubbish, and the column of water in the stand pipes, the pump is hereby prevented from catching its water; the usual remedy for which is, to draw the bucket out of the working barrel, until a quantity of water has escaped by its sides, and displaced the air. Observe here, that this often happens from the unnecessary magnitude of the space between the bucket and clack.

Thirdly.—The pumps are suspended in the pit by capstan ropes, for the purpose of being readily lowered as the pit is sunk; the stretching of the ropes, (especially when sinking in soft strata,) occasions much trouble, by suffering the pumps to choke; but the most serious evil is, that the sinkers, in shifting the pumps from one place to another, throw them very far out of perpendicular, thereby causing immense friction, and wearing in all the parts; besides endangering the whole apparatus, by breaking the bolts and stays, and straining the joints.

Fourthly.—As the pumps sink, the delivering pipe at the top is raised, by putting on short pipes, generally about a yard at a time, which occasions many stoppages and much hinderance in the work.

Having an engine pit to sink at Codnor Park Colliery, Derbyshire, belonging to the Butterley Iron Company, I endeavoured to obviate the difficulties stated; and, first, for the purpose of preventing the pumps working too much upon air, I constructed a working barrel, (which in this case was nine inches diameter,) with a side pipe three inches diameter, connected therewith by an opening at the top and bottom; also at the upper end of the side pipe I fixed a valve, so as to slide over and shut the communication with the working barrel, the stem of the valve by which it is regulated, passing through a stuffing box, and by letting a quantity of water return through the side pipe, to the bottom of the working barrel, (the men at the bottom regulating the valve, so that the pump takes the water as it comes,) very little rubbish is then taken into the pump, and much wear and tear of buckets prevented.

Secondly.—I also by this valve and side pipe, preclude the necessity of ever drawing the bucket to displace the air. The clack piece was made as small as possible, and the clack with its gearing very low, in order to have as little space as possible between the bucket and the clack. The clack as represented in the drawing, possesses the advantages of being easily caught by the clack hook, in case of being under water. The ring prevents it from oversetling, and thereby fastening itself in the pumps, and the valves are very easily repaired by unscrewing the cross-bar, which admits of their being taken off and replaced.

Thirdly.—I avoid the inconvenience of suspending the pumps by ropes, by forming the suction-pipe in two pieces, one inner and outer pipe, the outer pipe is bored for about six inches in length, and the inner one turned cylindrically to fit it; they slide into each other, the whole length of a regular pipe, viz. nine feet; and they are made tight by collars of leather, surrounded by a cup filled with water and clay. The pumps are supported at proper distances, so as to suit the length of the pipes by beams, and across those are other beams upon which the flenches of the pipes rest, these last are not fastened by any bolt, in order that they may be readily removed; the pumps by these means remain stationary, and the suction-pipe lengthens as the pit is sunk, until it is drawn out to its full extent. The whole column is then lowered to the next flanches, and another pipe is added to the top; the lower end of the suction pipe is formed some what like a crank, in order that the sinkers, by turning it round upon the other pipe, may move it from one place to another,

Mr. Wm. Brunton's Improved Pump for Mines.

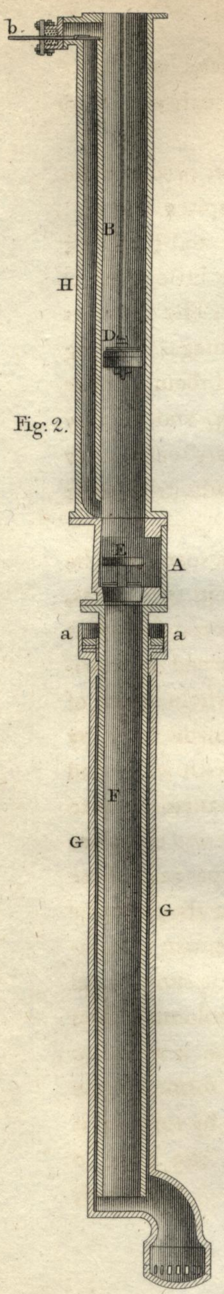


Fig: 2.

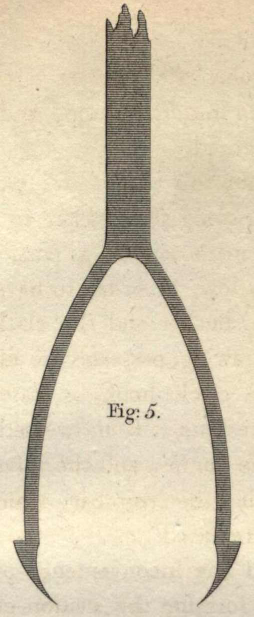


Fig: 5.

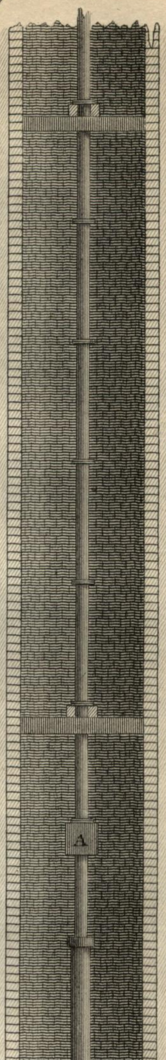
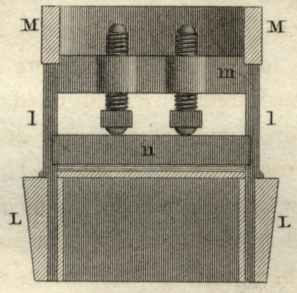


Fig: 1.

Fig: 3.



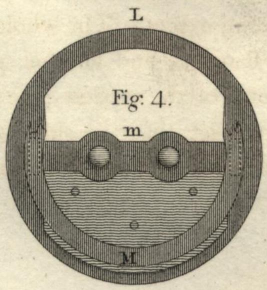
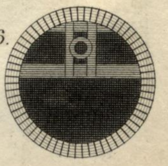


Fig: 4.

Fig: 6.



Drawn by J. Farey.

Engraved by S. Porter.

another, and so prevent the necessity of sinking immediately under it.

Fourthly.—The pumps being stationary as above-stated, the pipe at the top will of course deliver the water at the same level at all times, and instead of being obliged to lengthen the column every yard sunk, it will only be necessary every nine feet.

By sinking the pit above-mentioned in the manner I have stated, the whole of the difficulties so generally complained of were obviated, the safety of the workmen employed greatly increased, and much time, labour, and expence saved. If the above should appear to the Society deserving of their notice and patronage, or the publishing of it calculated for utility, they will thereby highly gratify and oblige,

Their most obedient humble servant,

W. BRUNTON,
Engineer.

Butterley Iron Works,
Derbyshire, October 20, 1810.

To C. Taylor, M. D. Sec.

Explanation of the Drawings of Mr. William Brunton's improved Pump, for Mining, and Sinking Shafts. Plate 5, Fig. 1, 2, 3, 4, 5, 6.

Fig. 1, is a section of a shaft or pit, with the pump fixed in it; it is cast in lengths of nine feet each, screwed together by flanches, and supported by beams extending across the pit, (as shown in the plan, fig. 6,) short pieces are laid across these, with half circular holes in them, these being put round the pump, just beneath a flanch, sustain the pump firmly, but may quickly be removed when it is required to lower the pumps in the pit; and, as they are not fastened, they do not prevent the pumps being drawn upwards; A, fig. 1, is the door which unscrews, to get at the lower valve or clack of the pump; this is more clearly explained in the enlarged section, fig. 2, where A has the same designation, B, fig. 2, is the working barrel, with the bucket D, working in it; E is the clack, also shewn enlarged in figs. 3 and 4; F is the suction pipe, and G G, the moveable lengthening piece; this slides over and includes the other, as in fig. 2, when the pump is first fixed; but, as the pit is sunk, it slides down over the pipe F, to reach the bottom, as in fig. 1; the outside of the inner pipe F, is turned true and smooth, and the inside of the outer pipe G, at the upper end, is bored out to fit it; the junction is made perfect by leathers placed in the bottom of the cup, *a a*, which holds water and wet clay over them, to keep them wet and pliable, and consequently air-tight; the lower extremity of the suction pipe G, terminates in a nose, pierced with a number of small holes, that it may not take up the dirt; this nose is not placed in a line with the pipe, but curved to one side of it, so as to describe a circle when turned round; by this means the sinkers can always place the nose in the deepest part of the pit, as shewn in fig. 1; and when they dig or blast a deeper part, they turn the nose about into it, the sliding tube lengthening down to reach the bottom of it; by this means there is never a necessity to set a shot for blasting so near the pump foot, as to put it in any danger of being injured by the explosion, as is the case in the common pump; in which this danger can only be avoided by moving the pump foot to one side of the pit, which necessarily throws the whole column of pumps out of the perpendicular.

The construction of the clack is explained by figs. 3 and 4, the former being a section, and the latter a plan; L L is a cast-iron ring, fitting into a conical seat in the bottom of the chamber of the pump, as shewn in fig. 2; it has two stems *l l* rising from it, to support a second iron ring M M; just beneath this, a bar *m* extends across from one stem to another, and has two screws tapped through it, these press down a second cross-bar *n*, which presses the leather of the valves down upon the cross-bar of the ring L, and this holds it fast, forming the hinge on which the double valves open, without the necessity of making any holes through the leather as in common; but the chief advantage is, that by this means the clack can be repaired, and a new leather put in in far less time than at present, an object of the greatest importance; for, in many situations, the water gathers so fast in the pit, that if the clack fails and cannot be quickly repaired, the water rises above the clack-door, so as to prevent any access to it, and there is no remedy in the common pump but drawing up the whole pile of pumps, which is a most tedious and expensive operation; in Mr. Brunton's pump, the clack can at any time be drawn out of the pump, by first drawing out the bucket, and letting down an iron prong, fig. 5, which has hooks on the outsides of its two points; this when dropped down will fall into the ring M, and its prongs springing out, will catch the underside and hold it fast enough to draw it up; another part of Mr. Brunton's improvement consists in the addition of a pipe H, fig. 2, which is cast at the same time with the barrel, and communicates with it both at the top and at the bottom, just above the clack; at the upper end the pipe is covered by a flat sliding plate, which can be moved by a small rod *b*, passing through a collar of leather; the rod has a communication by a lever, so that the valve can be opened or shut, by the men in the bottom of the pit; the object of this side pipe is, to let down such a proportion of the water which the pump draws, as will prevent the pump drawing air; though of course the motion of the engine will be so adapted, as not to require a great proportion of the water to be thus returned through the side pipe; yet it will not be possible to work the engine so correctly, as not to draw some air without this contrivance; and if it does, it draws up much dirt and pieces of stone into the pump, besides causing the engine to work very irregularly, in consequence of partially loosing its load every time the air enters the pump. Another use of the side pipe is, to let down water into the chamber of the clack to fill it, when the engine is first set to work, after the pumps have been standing still, and the lower part of the barrel and chamber empty.

DEAR SIR,

A GENTLEMAN whose name is Brunton, a very ingenious mechanist, who was many years with Messrs. Bolton and Watt, and who has now the management of the machinery of our iron-works and coal-mines, and also of a steam-engine manufactory established here, informs me, that last October, in your absence, he left at your house a drawing of a contrivance for facilitating the sinking of deep pits in coal works, or other mines, which are incommoded by water, which is, more or less, always the case.

The common practice is, by beginning with a short length of pump-trees, and adding to them at the bottom as the pit deepens, and particularly toward the termination of the work; it becomes a very difficult and hazardous operation, and causes a great loss of time and expence.

Mr. Brunton's contrivance to get rid of this operation, is to fix the pumps permanently as they descend, except the bottom length of pipe, which is to be turned true on the outside; and there is connected with it a similar length of pipe, bored true, so as to slide upon the other like a tube of a telescope, and it will lower inch by inch, as the depth increases; a still further improvement is, to join to the last mentioned pipe, a short length with an elbow, so that after deepening a hole near the foot of the pump, the elbow turning in the segment of a circle, suffers the loose parts of the pump to drop gradually, till it require an additional length to the permanent or fixed part of the pump-trees, which is performed in less than ten minutes, and the loose part being in the mean time slid up to its place, is again ready for proceeding with another nine feet in depth.

If you have the drawing with its explanation, it would be unnecessary to add more than to observe, that any gentleman of the Society, at all conversant with mining, will in a moment see what we have proved by the actual use of it, that, simple as it is, it will be an acquisition of considerable value to those that are interested in mining. I trust you will think it worth the notice of the Society.

I am, Sir,
Your most obedient Servant,

W. JESSOP.

Butterley Iron Works, Derbyshire,
Dec. 3d, 1810.

To C. Taylor, M. D. Sec.

The **Silver Medal** *and* **Twenty Guineas,** *were this Session voted to Mr.* **J. Allan,** *Blewitts Buildings, Fetter Lane, for a Reflecting Circle, in which the Screens can be readily shifted in taking Altitudes. The following Communication was received from him, an Explanatory Engraving is annexed, and one of these Instruments is preserved in the Society's Repository.*

SIR,

I beg leave to inform you, that on Thursday last, I left at the Society's house, a mathematical instrument, adapted for the use of mariners, which I wish to submit to the Society's attention. It is a Reflecting Circle, commonly called La Borda's Circle, for the purpose of taking altitudes and distances at sea; and which I have greatly improved lately, by fixing the shade glasses different to what had heretofore been done, with some other improvements as a Reflecting Circle. The late Dr. Mackay, in a publication of his, called Mackay's Longitude, has a plate of La Borda's original instrument, but the shade glasses are so fixed, as to render the instrument useless, and which he was convinced of on my pointing out to him the fault; he said he would alter his plate to my method, and that he would state it as my improvement; but his death soon afterwards prevented it. I am aware the Society do not confer their rewards without advantageous qualities to merit their sanction. I respectfully say, that I consider my instrument to have merit, both in œconomy, and in the great improvement made on the plan of the Reflecting Circle first invented. I shall be happy to point out this to the Society, and have the honour to be,

Sir,

Your humble Servant,

JAMES ALLAN.

Blewitts Buildings, Fetter Lane,
Dec. 24th, 1810.

To C. TAYLOR, M. D. SEC.

SIR,

AGREEABLY to the intimations of the Committee on Thursday evening last, I beg leave to explain to the Society, the properties of my improved Reflecting Circle; and which, with a Theodolite attached to it, would be useful both to the mariner and surveyor.

The Committee inquired what sort of center or axis the instrument had. I beg leave to state, it is an improved one of mine. The former way of centering this instrument, was only by a single pin, which both indexes acted upon; but the pin had so little bearing in the index, that it was not sufficient to keep the index-glass upright to the plane of the instrument in all its positions; I have therefore contrived to put what is called in our business, a male and female centre or axis, upon a simple but accurate method.

Permit me to make a few observations on circular instruments in general. I believe it will be universally allowed, that it is easier to make a circle nearer to truth, with respect to its horizontal plane, than it is to make a separate part of a circle so.

A sextant is only the sixth part of a circle, and is got flat by means of a plane, as near as the maker can get it, but is not turned on its own axis as a circle is; therefore I have no doubt, but that the best sextant usually made, is very short of the horizontal truth of a sixth part of a circle; and if we were to suppose a circle made of six of the usual sextants, it would be a very untrue circle with respect to its horizontal plane.

It has, therefore, been a general desideratum, that a circular instrument of reflection should be introduced, of simple construction, easy to adjust, and convenient for use. I have been induced to make several circular instruments of reflection in various ways, but none upon so simple a construction, or so cheap, as the present, nor so well calculated to prove any untruth, as my improvement upon Borda's; and I believe it will now be generally adopted for use.

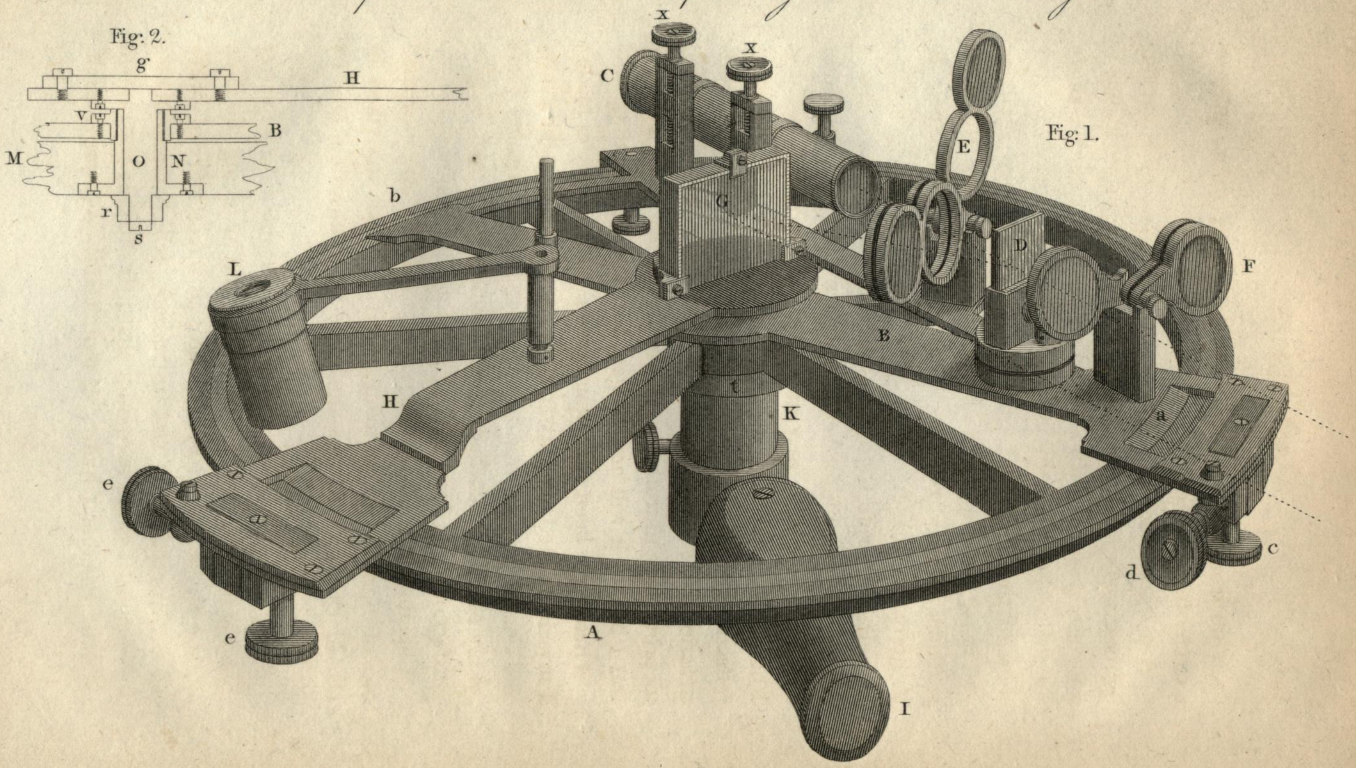
There have been great numbers of Borda's circles made; I myself assisted about twenty-five years ago to make many, also since I have been in business for the last twelve years on my own account, but I never found any of them to give satisfaction till I invented the present improvement.

Captain M'Lennan, who traded to South America, had one of Borda's Circles made, similar to that described in Dr. Mackay's Longitude, but could not use it till altered by me last April.

The glasses in my instrument are moveable to any quarter that a person may wish to use it in; and by taking the same angle with each quarter, it affords an opportunity of proving the correctness of the instrument, which circumstance I hope justifies me in saying, that it is the only instrument of reflection that I know, so well calculated to prove itself.

I beg

Mr. J. Allan's Improvement on the Reflecting Circle invented by La Borda.



Drawn by J. Farey.

Engraved by S. Porter.

I beg pardon for being so tedious; I assure you that I can make the instrument better than I can write or talk about it.

I have the honour to be,
Sir,
Your humble servant,
JAMES ALLAN.

Blewitts Buildings, Jan. 16th,
1811.

To C. TAYLOR, M.D. SEC.

CERTIFICATES.

A CERTIFICATE was produced from CAPTAIN H. C. COXEN, R. N., dated Feb. 5th, 1811, stating his opinion, that the dark screens which are fixed to Mr. Allan's Reflecting Circle, so as to act in the manner they do in a sextant, are improvements on the Reflecting Circle of Mr. Borda, which are not so fixed.

That it must be evident, even to the least experienced mariner, that there are frequent occasions, in taking the altitude of the sun, to change the screens *alternately*, in the shortest possible time, which cannot be effected in near so short a time by screens which take off and on, as in Borda's reflecting circle.

CAPTAIN MACKAY, who has commanded the Lord Forbes, in the Jamaica Trade, for twenty years, stated, that the manner in which Mr. Allan's screens are fixed in his Reflecting Circle, is a great improvement. That from not being obliged to take out the shades when the sun is clouded, the object is not lost; and that when an instrument is obliged to be taken from the eye, to fix the screen in the old mode, the object is lost.

That by this instrument being a Reflecting Circle, it makes sure of a horizontal plane well divided, which can hardly be the case in a portion only of a circle.

That Mr. Allan's is the most complete instrument he has ever seen, and that he shall always take one with him to sea.

Description of the Drawing of Mr. James Allan's Improvement, on the Reflecting Circle of Borda. Pl. 6.

THE Reflecting Circle, first invented by Tobias Mayer of Gottingen, and afterwards improved by the Chevalier La Borda, of Paris, is an instrument, which in its principle admits of such a degree of accuracy, as to be of the most important service to navigators; but it has hitherto been constructed in such a manner, that the inconveniences attending the use of it, have prevented its general adoption among seamen; any contrivances, therefore, tending to diminish these inconveniences, were deserving of the Society's notice. The construction of Borda's circle as they have hitherto been made, is minutely detailed in Dr. Rees's New Cyclopædia, article, Circle; and the mode of using it is there explained; it will be therefore unnecessary to describe any thing more of the circle delineated in pl. 6, than is essential to the elucidation of the improvements made by Mr. Allan.

The first of these is in the mode of applying the dark glasses, which are fixed on joints, so as to turn back out of the way, in the same manner as in the sextant; in the old instrument these glasses were fitted into sockets provided with tenants on the indexes, and fastened by a milled head screw, which took much time to change them; the second is the addition of double verniers to the index, carrying the telescope and horizon glass; these read upon opposite sides of the circle, and if a difference is observed between these readings by taking the mean of them, the error arising from any ex-centricity the index may have, will be corrected; and the third consists in fixing the index glass upon an axis, accurately fitted into the centre of the circle; by this means it is assured that the index glass in turning round, shall always be exactly perpendicular to the plane of the circle; in the old method, when the index-bar was merely fitted on a pin fixed in the center of the circle, it was impossible to make the circle so perfectly flat, or keep the index so accurately in contact with it, as by having an axis. To explain these improvements more perfectly, the reader is referred to plate 6, which contains a perspective view of the instrument; A, is the circle with six arms; B, is the index carrying the telescope C, and the horizon-glass D, with the two clusters of dark glasses E and F; at the opposite ends of this index are the two verniers *a* and *b*, the former has the clamp screw and slow movement attached to it, consisting of a screw *c*, which fixed the index to the circle; and *d* is the tangent screw, which will move the index a small quantity when turned, to adjust it accurately; G is the index mirror screwed upon the index H, which has also a vernier, and a clamp and tangent screw *e e*, similar to the other; I is the handle by which the instrument is held when in use; it is fitted to a socket K, which is screwed to the center of the circle, and is unscrewed from the circle when packed

away;

away; the handle is fitted to a springing socket, so as to turn round upon the socket K, that it may be turned to any side of the circle for the convenience of holding it; it may be fastened by a small milled nut, seen in the figure which binds the ends of the spring socket together; L, is a magnifying glass for the purpose of reading the divisions of the verniers; it is fitted upon a pin screwed into the indexes, and may be applied to either. The figure 2 in the corner of the plate is a section, shewing the construction of the central part of the circle, where M is a section of the thickness of the circle with a hole through the center, and a recess turned out in the lower side to receive a center piece N, which is fixed in with three small screws; a hole is turned in the center of this piece, and an axis O is fitted into it with the utmost accuracy, this axis has a flanch on the upper end by which it is screwed to the index H, and upon this, the under glass G, fig. 1, is fastened, by other screws passing through a piece projecting from the back of it; the axis is held in its place by a collet *r*, fitted on a square part of it, and held fast by a screw *s*; beneath this a piece is fixed on in the center of the circle, the edge of its flanch being shewn by *t* in fig. 1, it is part of the screw which holds on the spring-socket K, for the handle I, the upper end of the center piece N which comes up above the circle, is turned extremely true, and upon this the index B is fitted, or rather a brass ring *v* screwed to it, so as to turn round upon it as a center.

The telescope C, is fixed to the index by two cocks and by two screws *x x*, in these it can be raised up or lowered, to adjust the different brightness of the two objects seen in the horizon-glass D, the one reflected from the central mirror G, and the other seen directly through it; the dark glasses at E, are intended to moderate the light of the sun, in passing from the index to the horizon-glasses; the frames containing these glasses have holes E through them, to see through the telescope and horizon-glass, the other dark glasses F, are situated behind the horizon-glass D, and may be turned up or down as occasion requires.

The instrument is used in the same manner as the common Reflecting Circle; the angle being first taken on one side of the parallelism of the glasses, and then on the other; so that the angle is doubled, then it is repeated on a fresh part of the circle, as many times as the observer thinks proper, and the product divided by the number of observations taken; the mode of taking these observations is explained at full in Dr. Rees's Cyclopædia, and in Dr. Mackay's publication on the means of finding the longitude.

The SILVER MEDAL *of the Society was this Session voted to Mr.* JOHN HODGSON, *Charles Street, St. James's Square, for a Method of Correcting the Variations of the Mariner's Compass. The following Communication was received from him, an Explanatory Engraving is annexed, and the Instrument preserved in the Society's Repository.*

SIR,

I TAKE the liberty of requesting you, to submit to the Society for the Encouragement of Arts, Manufactures and Commerce, a small Theodolite, to which an addition has been made, calculated, it is hoped, to be of some utility.

The frequent recurrence to the variation of the compass, which is necessary in the use of the Theodolite, is always attended with trouble, and not unfrequently productive of error.

It appears to me, that by a very simple expedient, these inconveniences may in a great measure be removed. To the magnetic needle of the instrument, let one of brass be affixed moveable upon the center of the former; the brass needle may be termed the corrector. Nothing more is necessary than to place the magnetic needle and the corrector, at the angle of the variation, in such a manner that the former being in the magnetic meridian, the latter shall be in the true meridian. The south end of the corrector will point to the true bearing of an object, seen through the sights of the Theodolite.

I also beg to lay before the committee a ship's compass, in which will be found a different application of the same principle. In this instrument, the needle is made moveable under the compass card, so as to be placed by the officer of the watch, or any other proper person, under the variation line, as often as an azimuth or an amplitude shall have been taken. The points of the compass will, by these means, be directed to their corresponding points in the heavens, and the mariner will know that he is really sailing upon the rhumb indicated by the cord.

I am inclined to think that a seaman may sometimes be liable to error, in the continual reference which it is necessary for him to make to the variation of the compass, from a possibility of his allowing it on the wrong side, by substracting where he should add, or by adding where he should substract it; even under a supposition that such a mistake is not likely to occur, the use of this instrument as an additional check, in a matter of so much importance as is the ascertaining of a ship's course, may not be entirely unworthy of attention.

It is very probable, that from my imperfect information upon these subjects, I am now proposing what has before been suggested, and been found either to be wholly impracticable, or of little or no utility when reduced to practice. This is indeed the more probable from the extreme simplicity of the expedient itself, which could scarcely have escaped the attention of the many enlightened seamen, and others, who have devoted their minds to subjects of this nature. This consideration, however, is not sufficient to induce me to lose a chance of suggesting any, the most trifling hint, which may be useful to a class of men, to whom we are so much indebted.

It may be objected against the application of this principle to a ship's compass, that as the variation in a long voyage is continually changing, the card in a short time after it has been adjusted, will not point truly. This must be admitted, but it must also be recollected that it will agree with the last variation ascertained, and which is that on which the mariner must rely, until a fresh observation shall have been taken.

It may also be objected, that through the negligence of the persons employed to regulate this instrument, errors may arise, equal to those which it is intended to obviate; but surely, whatever may tend to afford a correct knowledge of a ship's course, is of sufficient importance to render the adjustment of the card an office by no means unworthy of the Captain himself; and it cannot be supposed that he, or indeed any other officer, can be liable to error in an operation merely manual.

If we admit, however, that these objections are well founded, an instrument of this description might not be destitute of utility, placed in the Captain's cabin, or some other convenient part of the ship, where it might continually indicate her course, without the necessity of a reference to the last observation; and at the same time serve as a check upon the several courses entered from the steering-compass.

Whatever obstacles may exist to the application of this contrivance to the ship's compass, I apprehend that there will be none to its utility, as applied to the instruments used in land surveying; confined as that business is to tracts of country, within which only a trifling annual variation takes place, and to which variation the corrector may be set whenever it becomes considerable.

To the common boat and pocket-compass, the same principle may be applied with equal utility; to the latter especially, which may frequently, perhaps, be in the hands of persons unacquainted with either the bearing or amount of the variation of the magnetic needle.

As the instruments submitted to the Committee are merely intended for illustration, I have not aimed at great nicety in their mechanism. It is obvious that they are capable of considerable improvement, and that both the Theodolite, and the ship's compass, may be so constructed, as to be capable of all requisite accuracy in their adjustment, without loading them in such a manner as to obstruct the free motion of the needle.

If a modification of these instruments, in itself so simple, shall be found to be of the least utility, I shall feel highly gratified.

I am, Sir,
Your very obedient servant,
JOHN HODGSON.

Charles Street, St. James's Square,
April 23d, 1811.

To C. Taylor, M.D. Sec.

Reference

Mr. Hodgson's Improved Compaſs.

Fig. 1.

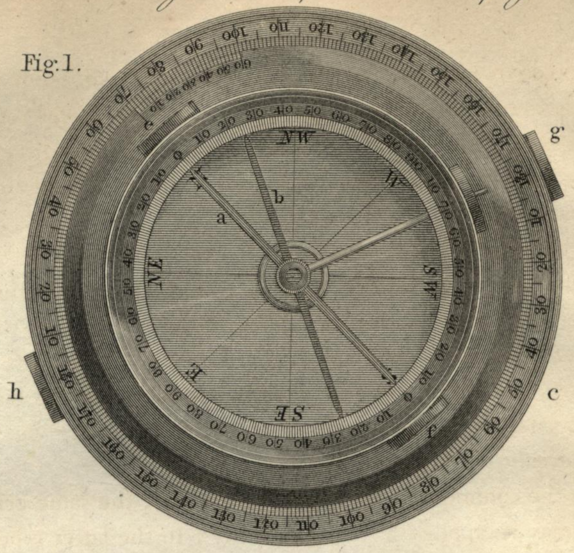
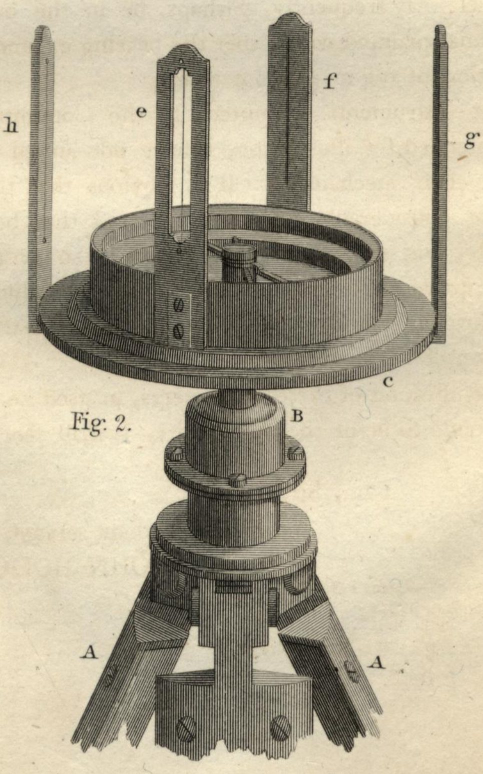


Fig: 2.



Drawn by J. Farey.

Engraved by S. Porter.

Reference to the Drawing of Mr. John Hodgson's Variation Compass. Plate 7, Fig. 1 and 2.

THE two figures in this plate are, a plan and perspective view of a small theodolite or circumferentor, for taking horizontal angles by the magnetic needle; it is to the latter alone that Mr. Hodgson's improvement applies; being a brass needle *a*, fig. 1, which is fitted upon the brass center piece, or cap, of the real needle *b*, in such a manner that it can be easily turned round to make any angle with the needle, and having sufficient friction to remain where it is placed; both needles are poised on the same center point, with an agate cap in the usual manner, the brass needle being only an index to point out the divisions on the circle within the compass; this index being set so as to make the same angle with the needle, as the difference of the true and magnetic meridians, will at all times give the true bearings of any object observed through the two sights *e* and *f*, which are diametrically opposite, and at the zero of the divided circle; at least whilst the variation of the needle continues the same; but as this alters by the instrument being used in a different tract of country, the brass index *a* must be turned round a corresponding number of degrees which are shewn by the divided circle in the box. The remaining parts, shewn in fig. 2, are A A, the upper ends of the tripod supporting the instrument; B the ball and socket by which the box is adjusted, so as to be horizontal; the stem of the ball has a circle *c* fixed to it, carrying two sights *g b*, through which the observations are taken; the circle *c* is divided into degrees, and the compass-box, which turns round upon it, has a vernier applying to them; this renders the instrument a theodolite, as any two objects may be observed through the sights *ef*, and *g h*, and the divisions on the circle *c*, will denote the angle between them; and at the same time the bearing of any object may be taken by observing it through the sights *ef*, and noting the degree pointed out by the brass needle *a*, which is the true bearing required, without any allowance for the variation, as was the case in the common instrument.

The SILVER MEDAL *of the Society was this Session voted to* HENRY EARLE, *Esq. of Hanover Square, for an improved Bed for Persons whose Limbs are fractured, or who are sick and infirm. The following Communication was received from him, an Explanatory Engraving is annexed; a Model of the Bed is preserved in the Society's Repository, and the Letter, or Printed Tract, alluded to, is placed in the Society's Library.*

SIR,

THE well-known zeal which your most useful and excellent Society has ever evinced, in whatever concerns the public good, has induced me to send the model which will accompany this, for their inspection. It consists of a double bed, for the relief of such persons as from accidents or disease, are rendered incapable of moving, when it is necessary to obey the dictates of nature. The first was constructed about four years since, after having seen a poor fellow, who had broken both thighs and his left arm, and who, in consequence of the impossibility of being moved, was in a state almost too dreadful to describe, from the accumulation of fæces and maggots. I cannot here omit expressing my surprize, that so material a consideration as this should have been so long neglected, particularly as in many cases it really appears almost indispensably necessary. I have since that time had frequent opportunities of witnessing the very great comfort and ease which this contrivance has afforded, both to patients and their attendants. I feel it a duty incumbent on me, to render public an invention which is of such great consequence to Society at large. It arose from my finding the absolute necessity for such a contrivance. In its construction, simplicity and utility have been my study; the comfort and relief of persons in a most helpless and distressing situation, have been my object. I am aware, that the true value of such an invention can only be estimated by medical men, who have witnessed the mortifications, and even fatal effects, which arise from a want of cleanliness in this particular, and by such persons as have themselves been subject to the miseries which I have described. By means of this contrivance, patients in the very worst state may enjoy all the luxuries of cleanliness and ventilation. There is another object which the same contrivance has been made to answer, which is of nearly equal importance with the one just mentioned. It frequently happens, that it is necessary to raise patients to dress wounds on the back, and to place fresh linen under them. This cannot be accomplished where there is any fracture without great difficulty, and requires a number of assistants, who become weary before the dressings, &c. are ready. The present contrivance is eminently adapted to remove this difficulty; by it, the patient may be raised from the bed for any length of time, without the least inconvenience or derangement of the fractures. The first person I tried this on, was a stout drayman, a patient of Sir Charles Blicke's, who had a compound fracture of both legs; this man was almost daily raised to have an ulcer on his back dressed, without experiencing any pain, and the broken bones remaining undisturbed. I believe I may very fairly attribute the well-doing of this case, in a great measure, to the perfect quietude in which the limbs were preserved. Another great advantage in this contrivance is, that it may be entirely managed by a single person. I have also made the frame of the upper bed rise at either end, independent of the opposite one. This may sometimes be useful, but is not to be considered as a very material object. The beds which were made for the use of St. Bartholomew's Hospital were compleat, both upper and lower bedstead. I have since managed, that the apparatus may with ease be fitted to any bed, at an inconsiderable expence, in order to adapt it to more general use. I will not intrude any longer on your valuable time, by a detail of the particular cases to which this bedstead is applicable; suffice it to say, that in all cases where perfect quietude of the body and lower extremities is necessary, this contrivance will be found of infinite service. If any further account is required, I shall beg to refer you to a letter which my father published some time since, on fractures of the lower extremities, in which this bed is fully described. I have taken the liberty to send one of these letters, of which I beg your acceptance, and remain,

Sir,

Your obedient humble servant,

HENRY EARLE.

Hanover-square, December 19, 1810.

To C. Taylor, M.D. Sec.

DEAR SIR,

THE model which I had the honour of presenting to the Society at its last meeting, being imperfect, I have taken the liberty of sending another, which will, I hope be found more complete, and is much less complex and expensive. I should feel myself obliged if you would explain, when it is next taken into consideration, that the first model was not intended as a correct representation of what I meant the real bedstead to be. It was only the principle which I was then desirous of submitting to the inspection of the Committee; the one which will accompany this is a precise model of the apparatus, which I propose to be manufactured for the future.

The principal difference consists in its capability of being adapted to any bedstead, without putting a single screw into, or otherwise damaging such bedstead. The frame is also kept perfectly steady, and when it is necessary to raise the rack, independent of the frame, it is effected in a much more simple manner. I subjoin to this an account of the frame, &c., though it will be much better understood by a view of the model, than any verbal description.

I remain, with great respect,
Dear Sir,
Your obedient servant.

HENRY EARLE.

Hanover Square, January 9, 1811.

To C. TAYLOR, M. D. SEC.

Mr. Earle's Description of his Apparatus.

THE apparatus consists in a frame of wood, of the length of a common bed, and about three feet six inches or four feet wide. Across this frame a strong ticking is strained, and fastened by buckles and straps, as in the model, or it may be corded like a common bed. In the centre of this ticking an aperture is made, of about four inches in diameter. This opening is closed when not used by a stripe of ticking, which passes across the frame, and is buckled to the opposite side. This frame is to be placed on the featherbed, mattress, &c. of a common bed, and covered with a blanket and sheet doubled, and placed above, and another below the aperture, or a hole may be cut in the blanket and sheet.

The frame is raised by two racks, which pass through mortices at its top and bottom; the frame is connected to the racks by chains, which proceed from its corners to the top of the racks, and which hook on to any height that may be required. The racks are worked in boxes by a wheel and pinion; a long spindle connects the two pinions, by which one handle raises the two ends at once; this spindle runs under the frame of the under bedstead. Each box containing the wheels is fixed to the rail of the under bedstead by two strong flat staples, which are fastened to the back of the box. When the patient is to be raised, independent of the frame a cross-bar of iron is fitted to the top of the racks; broad girths are to be passed under different parts of his body, and connected to this bar, the chains are to be undone, and the handle turned round, when the frame being no longer connected with the racks will remain stationary, whilst the patient is gradually raised and suspended from the bar.

When it is desirable to raise one end of the frame higher than the other, it is accomplished by unhooking the chains from the opposite end to that which is to be elevated. In all these motions the descent of the rack is prevented by a a stop, which is passed between two of its cogs.

The price of this apparatus, if made of cast iron, will I believe be under five pounds.

HENRY EARLE.

Letter and Certificates.

DEAR SIR,

I HAVE just learned that you intend presenting to the Society of Arts, &c. a model of your very ingenious bedstead. I hope I may not be too late in offering my testimony of its great utility, and the comfort and ease which it affords to invalids under a variety of circumstances.

The evident advantage of this construction induced the Governors of St. Bartholomew's Hospital, to order some to be made, which have been for many years in constant and improved use. In compound fractures of the leg especially, I have considered it as nearly indispensable, as almost all the duties requisite may be performed to the patient, without the danger of disturbing the limb, and for such cases I have principally used it in the hospital.

Sincerely hoping that you may have the gratification of seeing your benevolent invention adopted in general practice,

I remain, Dear Sir,

Your sincere friend and humble servant,

LEDFORD HARVEY.

St. Bartholomew's Hospital, Dec. 19, 1810.

To HENRY EARLE, ESQ.

A CERTIFICATE was received from SIR CHARLES BLICKE, of Bedford Place, dated December 19, 1810, stating that he had much pleasure in offering the opinion he entertained of Mr. Earle's double bed. That he had often witnessed and experienced in St. Bartholomew's Hospital its utility upon urgent occasions, arising from serious accidents, and also the great comforts it affords to the patients.

A Certificate was also received from THOMAS WHEELER, ESQ. dated St. Bartholomew's Hospital, December 19, 1810, stating the agreeable sensation he had on observing, in St. Bartholomew's Hospital, the great comfort resulting from the use of Mr. Earle's double bedstead, to patients labouring under various infirmities. That the benefits and accommodations of it are so great, as to entitle his useful invention to the notice of the public.

A Certificate was also received from THOMAS RAMSDEN, ESQ. dated College of Physicians, December 21, 1810, stating, that he had seen the double bedstead which Mr. Henry Earle had submitted to the Society of Arts, &c. applied to the accommodation of patients under injuries to their limbs, which would have rendered it quite impossible for them to have been removed for the purpose of cleanliness, by any other means ; and that he therefore thinks highly of its utility.

Referenceto the Engraving of Mr. Henry Earle's Bedstead for Invalids. Plate 8, Fig. 1.

A B are the side rails, C the head, and D the foot rails of a common bedstead, to which an elevating frame is adapted

Mr. Hy. Earle's Bedstead for Invalids.

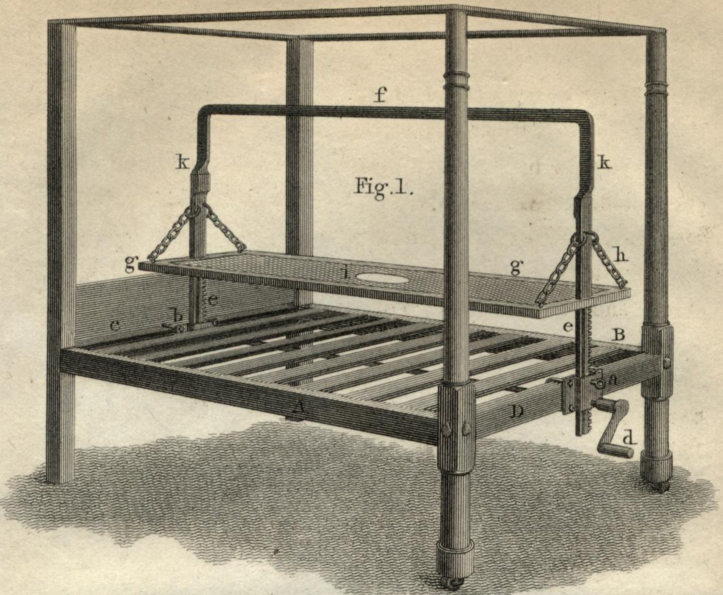


Fig. 1.

Mr. John Fuller's Improved Scarificator.

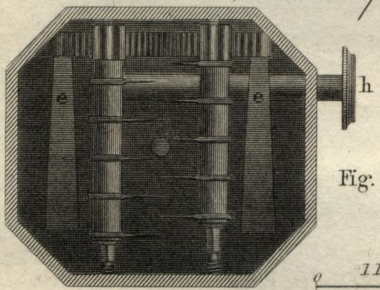


Fig. 2.

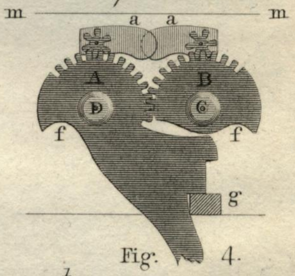


Fig. 4.

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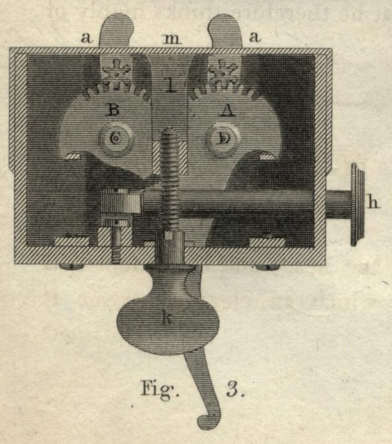


Fig. 3.

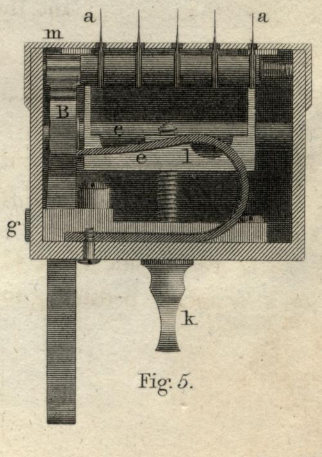


Fig. 5.

Drawn by J. Farey.

Engraved by S. Porter.

adapted in tht following manner: Two small iron frames or boxes *a b*, are fastened to the head and foot rails, by a pair of iron staples fixed to each, which encompass the rails, and by nuts screwed upon the ends of the staples; the boxes are thus firmly fixed to the rails, without making any hole in them; each of these boxes contains a pinion connected together by means of an iron axis, extended from one to the other, so that both are turned at the same time by the handle *d*, and elevate their respective racks, *e e*, from which the frame *g g*, is suspended by the chains *h*; the frame *g g* is made of wood, about four feet wide, and of the same length as the bedstead frame; and the racks pass through mortices made in the end rails of it, so that unless the chains are hooked on, the racks rise and fall independent of it; this gives an opportunity, if the case of the patient requires it, of inclining the frame upwards, by detaching the chains at the feet, and raising up the racks; the head one, which has the chains hooked on, raises up the head of the frame, leaving the feet resting on the bedstead; the racks may be secured at any elevation, by pins put through holes in the boxes *a* or *b*, which then catch between their teeth, and prevent them being moved until the pin is withdrawn; *f* is an iron bar or rod extending from one rack to the other, this bar is used to elevate the patient independent of the frame *g g*; when this is used, the chains are unhooked, and linen bands are passed under the invalid, who is supposed to be lying upon the frame, and the ends tied to the iron rod; then by turning the handle, he is elevated off the bed and frame, and may be suspended whilst the bed is made beneath, and then lowered down upon it without injury or much inconvenience. When the adjusting frame is used alone for elevating the patient, either for making the bed, or for introducing a bed-pan, &c. beneath the frame, the iron bar is removed; and for this

purpose

purpose it has tenants at its ends, which are dropped into sockets made in the tops of the racks at *k k*; *i* is an aperture in the ticking of the frame *g g*, through which the patient without being disturbed, may discharge his fæces or urine, when the frame is raised for that purpose, and a vessel placed under the aperture to receive them.

The SILVER MEDAL *was this Session voted to Mr.* JOHN FULLER, *No.* 14, *Hatton Garden, for an Improved Scarificator. The following Communication was received from him, an Explanatory Engraving is annexed, and one of the Implements is preserved in the Society's Repository.*

SIR,

I WISH to submit to the notice of the Society an improvement in the construction of the Scarificator, and which I flatter myself will be found worthy their attention. It may be necessary to premise, that the Scarificator is an instrument used in cupping for making the incisions, from which blood is afterwards obtained by means of exhausted glasses. As the degree of pain caused by this operation, depends on the good or bad quality of the Scarificator, this instrument has always been an object of attention. The best Scarificators generally in use propell from ten to sixteen lancets, through about half a circle, which is effected by a part, termed the rack, moving on its centre or part of its edge. On part of its edge are situated teeth, which are so confined that by moving the cock or tail of the rack, they work three pinions, and make them revolve about half a round: it is evident that lancets fixed on the axis of these pinions must also have a circular motion, and endeavour to cut any thing opposed to their passage; it is likewise evident that if a spring be so set that it can be released, and its force applied on a sudden to the rack, (somewhat similar to the main-spring of a gun-lock) all the lancets will be carried forward at once, and that with a force and velocity in proportion to the strength of the main-spring. The objections to this construction, and which frequently occur in practice are, that from the number of lancets necessarily used, the resistance to their motion is so great, that they do not move with the swiftness requisite to the ease of the patient; it is likewise often desirable to have the incisions rather deep, and then they are often quite stopped in their progress; besides this, by the lancets all moving one way, they are found to drive the skin up in folds, and thus present additional resistance, and occasion excessive pain to the patient; if to obviate these inconveniences the main-spring be made very strong, it is then, from its confined situation, exceeding liable to break, and if this does not happen, another inconvenience is produced, viz. from its very great strength it is scarce possible for any person to cock and discharge it with the requisite ease.

It was therefore suggested, that if two rows of lancets could be made to move in contrary directions, these, by keeping the skin equally stretched, would form clean incisions with much less force than in the former method: The Scarificator A, marked No. 1, was therefore constructed, and first used early in 1802; it is accompanied by its working model B; this instrument at the first contained the twelve long-edged spiral lancets C. This instrument immediately shewed its theory to be good, but it had its faults, the incisions were too long when of the necessary depth; from the complex nature of the two racks, &c. and from the confined situation to which they were restricted, they could not be placed in the most favourable position for motion, and was therefore liable to be out of order; these and many other objections were altered or removed in various ways, which at length terminated in the construction of the instrument D, marked No. 2, also containing twelve lancets, combining every advantage and improvement suggested by experience and reflection. This instrument admits of two main springs, but from the manner in which the racks work in each other, and in their respective pinions, they in effect become one, but maintain the advantage of being made more slight, and consequently admitting a greater extent of motion than a single stiff spring can possibly accomplish; besides which they are not so liable to break; and should this happen to one, the instrument would not be useless, for I believe that one of these springs would be strong enough for all ordinary purposes, as incisions are effected with much less force when the lancets diverge, but combined they never have shewn the least disposition to stop, however deep it might be necessary to set them, or strong the integuments to which they were applied; and consequently attended with greater ease to the patient. On inspecting the instrument and working model E, its simplicity, I flatter myself, will be admitted ; nor is any force of the main-springs spent in overcoming unnecessary friction or ill-directed motion; the ease likewise with which the instrument is discharged, considering its strength of spring, will be noticed by every one accustomed to Scarificators. It may be objected to this instrument that it is larger and heavier than the ordinary Scarificator, but it is capable of being reduced without injury to the improvement, as is shewn by the instrument F, which is completely within the usual size.

I have been favoured with testimonies of approbation from the following respectable gentlemen. Dr. Willan, physician; Mr. Armiger, Mr. Frampton, and Mr. Lawrence, Surgeons and teachers of anatomy.—It will be also seen that while in the possession of Mr. Armiger, it was approved by the late Dr Rollo, and by Dr. Irwin, the present Surgeon-general and Inspector of Ordnance Hospitals; and I may add as a further proof of its utility, if more be necessary, that by an illiberal use of private confidence, others have been made on a similar plan, and I am misinformed if the honour of this invention has not been claimed, within these few months, by three or four different individuals.

Accompanying this is another Scarificator, G, the peculiarity of which consists in the lancet being projected directly forwards, and returning into the box or case; the washing model N is not exactly such as is contained in the instrument, but an improvement on it. This instrument and model must be considered merely as experiments, to see how such motion could be effected; for, persuading myself that punctured wounds would be more painful and more difficult to heal in this, as they usually are in other circumstances, compared with incised wounds; and likewise having so happily succeeded in constructing that already described, which I consider so far superior, I never used it, and therefore can say nothing as to its operative merits; nor should I have recalled it from oblivion, but having lately seen a description of a Scarificator by punctured wounds, invented by a very ingenious and respectable medical gentleman, who speaks very satisfactorily of its performance, and which does not possess the advantage of the lancet withdrawing from the wounds, but are removed with the instrument, I thought, that should mine be a mistaken opinion, and that some real advantage attends this method, it occurred to me that submitting the instrument to the Society, would be applying it to its best use; as from its possessing the property of the lancets withdrawing themselves, it might suggest some ideas for further improvement.

I am, Sir,

Yours obediently,

JOHN FULLER.

No. 14, Hatton Garden.

To C. TAYLOR, M.D. SEC.

CERTIFICATES.

A CERTIFICATE was received from T. J. ARMIGER, Esq. dated Theatre of Anatomy, Bartletts-court, Holborn, February 20th, 1811, stating, that the manner in which the lancets make the incisions by diverging, is well calculated to extend the skin during the action of the instrument.

That being at Woolwich in July, 1807, he shewed Mr. Fuller's instrument to the late Dr. ROLLO, and to Dr. IRWIN, the present Surgeon-general and Inspector of Ordnance Hospitals, who both highly approved of it.

A Certificate from HEATHFIELD T. FRAMPTON, Esq. dated St. Mary Axe, February 26th, 1811, stating, that the principle upon which Mr. Fuller's Scarificator acts, appears to him a considerable improvement, not only upon those in general use, but also upon that constructed by Mr. Fuller many years ago, in which the lancets strike perpendicularly. That he thinks Mr. Fuller will do well to make the instrument publicly known, that it may be brought into general use.

A Certificate from WILLIAM LAWRENCE, Esq. dated Giltspur-street, March 22d, 1811, stating, that he has examined the Scarificator invented by Mr. Fuller; that the principle adopted in this instrument, of making the lancets diverge when they are discharged, seems to him to possess great advantages over that of the Scarificator in common use, and that the mechanism seems very well calculated to secure all the advantages which this principle can produce.

A Certificate from ROBERT WILLAN, M. D. dated Bloomsbury-square, March 6th, 1811, stating, that the new plan of a Scarificator, as constructed by Mr. Fuller, appears to him worthy of attention and encouragement, since it must diminish the inconveniences arising in, and after, the operation for which it is employed.

Description of the Engravings of Mr. John Fuller's Scarificator. Plate 8.

Figs. 2, 3, 4 and 5, are sections of this instrument, taken in different positions, to explain its interior mechanism; fig. 2, is a plan of the lancets, the top of the box being removed to shew them; fig. 3, is a section through the center of the box; and fig. 5, the same, but taken in the opposite direction.

The lancets *a a*, figs. 3, 4 and 5, are fixed upon two small arbors mounted parallel to each other, across the box; the lancets are so arranged on the arbors, that those upon one arbor are placed in the intervals between the lancets fixed upon the other; the arbors are placed near the top of the box, and the lancets act through clefts cut in the lid, (as shewn in figs. 3 and 5,) when the arbors are turned round; this is performed by a pinion upon each arbor, receiving motion from two toothed sectors, A B, and which are also caused to act together by the teeth on their edges; they are fixed upon two parallel spindles C D, which extend across the box; the sector A, has a lever or handle attached to it, and coming through the bottom of the box, and by pulling this, the Scarificator is wound up ready for action. The power is given by two horse-shoe springs, *e e*, figs. 1 and 5, one end of each is screwed upon the bottom of the box, and the other acts in a notch *f f*, in each sector, so as to press those sides upwards; the sectors are prevented from moving, except when required by a catch *g*, which enters notches cut in the handle of the sector A; this catch is a brass bar, laying across the bottom of the box, as shewn in figs. 3 and 5, it moves on a screw as a center pin at one end, and is pressed towards the sector by a slight spring (not seen); when it is to be discharged, a button *h* is pressed in, which disengages the catch *g*, from the notches in the piece A, and permits the springs to turn the sectors about, and by their teeth acting in the pinions, turns the lancets round at the same time, which is effected by the teeth of the two sectors engaging each other, in order that they may not operate so as to move the whole instrument upon the skin, as is the case in the common scarificator.

Fig. 4, shews that the handle of the sector A has two notches in it, for the catch *g*, when it is caught upon the first of these, the instrument is in the position of fig. 3, which is the half-cock, the lancets standing directly upright out of the box; in this position, the depth they are intended to penetrate, is adjusted by means of a screw *k*, passing through the bottom of the box; it is tapped into a piece of brass *l*, which is screwed to the lid *m* of the box; the piece of brass is bent, as shewn in fig. 5, that it may clear the lancets and their spindles; when the screw is turned, it is evident that it will raise or lower the lid of the box, and cause the lancets to protrude more or less through it, and consequently enters a greater or less depth into the skin.

When the instrument is to be used, the handle of the sector A is to be drawn back into the position of fig. 4, which is at the full cock; the lancets are now turned down wholly within the box, and the springs wound up; the lid is then to be applied flat upon the raised-up skin of the part to be scarified; and by pushing in the button *h*, the catch *g* is moved round on its center pin, and pushed out of the notches in the handle of the sector A; the springs now turn the sectors, and the lancets fly out of the box with inconceivable rapidity; and making as many punctures in the skin, return into the box, having made exactly half a turn with their respective arbors. The dimensions of the instrument may be ascertained by the scale of inches annexed to the drawing.

TWENTY GUINEAS *were this Session voted to Mr.* GEORGE PRIOR, *Jun. of Otley, in Yorkshire, for an Improved Remontoire Escapement for Pendulum Clocks. The following Communication was received from him, an Explanatory Engraving is annexed, and a Model is preserved in the Society's Repository.*

SIR,

HAVING invented and made a remontoire escapement for long or short pendulum clocks, which I think will be much approved of, I have taken the liberty to send you a model, with a drawing and description of the same, which I shall thank you to lay before the Society for the Encouragement of Arts, Manufactures and Commerce.

In this escapement there is not any more friction than in that which I had the honor of obtaining a bounty and a medal for, from your very honorable Society, in 1809, by whom it was allowed to have much less friction than any before invented. The advantage of this escapement is such as certainly to give the same exact and equal impulse to the pendulum without any friction, and which cannot be at all affected by any irregularities or variations arising by the clogging of oil and increasing of friction from the train, except during the very small part of the vibration that the pendulum is removing the spring detents from off the points of the teeth of the escape wheel, the effect of which can never be discovered in the rate by any variation the oil on the pivots and the increase of friction can ever produce, as long as the wheels will be able to wind up the renovating spring, which will be nearly as long as they can move at all, as the renovating spring has not either to be wound up quick, or to be pushed beyond any catch or spring to keep it in its proper situation, nor can there ever be any increase of friction in winding-up the renovating spring, as it is formed in as near a right line as possible; consequently must go almost endless without cleaning, and will never require any oil, (if all the parts of friction in the whole escapement be added together, they will not amount to the breadth of the acting part of the pallet of a common vertical watch verge, which every watch-maker knows acts without oil) still keeping the pendulum vibrating up to the same arc, which of course cannot avoid keeping time, if properly regulated for expansion, and which must be a very desirable

Mr. Geo: Prior Junrs. Improved Remontoire Escapement.

Fig: 1.

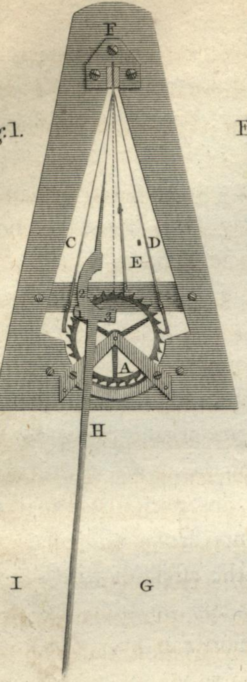


Fig: 2.

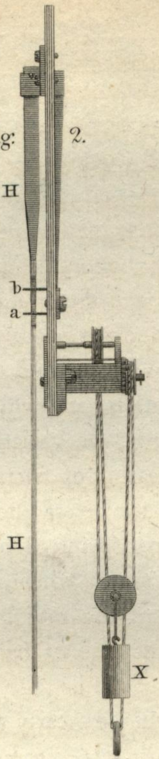
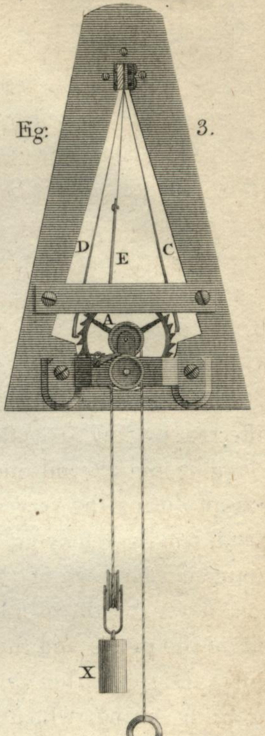


Fig: 3.



Mr. Richard Bridgen's Head Piece, to obviate the ill effects of Water Gilding.

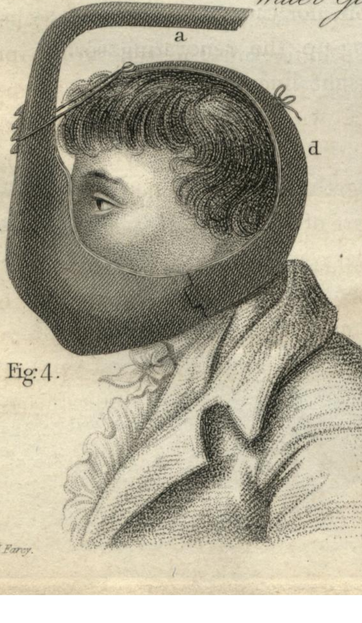


Fig: 4.

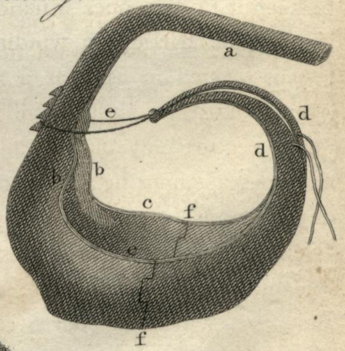


Fig: 5.

Drawn by J. Farey.

Engraved by S. Porter.

desirable attainment for regulators, for astronomical and other observations, where the greatest accuracy is required, as regulators once properly regulated, ought to go as long as can possibly be contrived, without making the slightest alteration in them.

The complex contrivance of all remontoire escapements I am acquainted with, has always prevented their use, as no good performance, except for a short time, can be produced from them, as they are all liable to want frequent oiling or cleaning; even Mr. Massey's, rewarded by the Society of Arts, Manufactures and Commerce, which is the most simple and best that I know, must frequently want oiling, or it will stop, owing to the friction of the teeth of the escape wheel in sliding up the inclined planes of the renovating springs to wind them up.

I am, Sir,

Your most obedient servant,

GEORE PRIOR, JUN.

Yorkshire, Otley, April 8th, 1811.

To C. TAYLOR, M. D. SEC.

Explanation of the Engravings of Mr. George Prior, Jun.'s, Remontoire Escapement. Plate 9, Figs. 1, 2 *and* 3.

THE swing wheel A, figs. 1 and 3, has thirty teeth cut in its periphery, and is constantly urged forwards by the maintaining power, which, in the model represented in the engraving, is supplied by a small weight X, figs. 2 and 3; CD are two spring detents catching the teeth of the wheel alternately; these are, at the proper intervals, unlocked by the parts marked 2 and 3, fig. 1, upon the pendulum rod H, intercepting small pins *a b*, fig. 2, projecting from the detents, as it vibrates towards the one or the other; E is the renovating or remontoire spring, fixed to the same stud F as the detents; it is wound-up by the highest tooth of the wheel, as seen in fig. 1, (its position when unwound being shewn by the dotted line). This being the case, suppose a tooth of the wheel is caught by the detent D, which prevents the wheel from moving any further, and keeps the renovating spring from escaping off the point of the tooth; in this position, the pendulum is quite detached from the wheel; now, if the pendulum be caused to vibrate towards G, the part of it marked 2 comes against the pin *b*, fig. 2, projecting from the renovating spring E, and pushes this spring from the point of the wheel's tooth; on vibrating a little farther, it removes the detent D, which detained the wheel, by the part 3 striking the pin (*a*, fig. 2) which projects from the detent; the maintaining power of the clock causes the wheel (thus unlocked) to advance, until detained by a tooth resting upon the end of the detent C, on the opposite side; by this means the renovating spring will be clear of the tooth of the wheel as it returns with the pendulum, and gives it an impulse, by its pin *b* pressing against the part 2 of the pendulum, until the spring comes to the position shewn by the dotted line, in which position it is unwound, and rests against a pin fixed in the cross-bar of the plate; the pendulum continues vibrating towards I, nearly to the extent of its vibration, when the part 1 meets the pin in the detent C, and removes it from the wheel and unlocks it; the maintaining power now carries it forward, pushing the renovating spring E before it, until another tooth is caught by the détent D, which detains the wheel in the position first described, the renovating spring being wound up ready to give another impulse to the pendulum.

N. B. The pin *b*, fig. 2, is not fixed to the renovating spring itself, but is part of a piece of brass, which is screwed fast to the renovating spring, and is made very slender near the screw which fastens it; this permits the end of the renovating spring to give way, if, by the weight being taken off the clock, or any other accident, the escape-wheel should be moved backwards, so as to catch on the detents improperly.

The following observations are necessary to be attended to in this Escapement.

1st. That the renovating and detent springs must spring from one centre, and as similarly as possible.

2d. That the force applied to the train must be so much more than what will wind up the renovating spring, as will overcome the influence of oil and friction on the pivots of the machine.

3d. That the renovating spring when unwound, must rest against the point of the tooth of the wheel, which will be an advantage, as it thereby takes as much force off the tooth of the wheel resting against the detent spring, as is equal to the pressure of the renovating spring C, against the face of the tooth of the wheel.

4th. The detent springs must be made as slender and light as possible, though whatever force they take from the pendulum, by their elasticity in removing them to unlock the wheel, so much force they return to the pendulum in following it, to where it removed them from, therefore action and reaction will be equal in contrary directions.

5th. That it is unnecessary for the pendulum to remove the detent or renovating springs, much further than is necessary to free the teeth of the wheel, as it will always vibrate up to the same arc; in table clocks it ought to remove them further, so that it can go when not placed exactly level, or what is generally termed, out of the beat.

TWENTY GUINEAS *were this Session voted to Mr.* RICHARD BRIDGEN, *No.* 61, *Broad-Street, Bloomsbury, for his Invention of a Method to prevent the Inhalation of Noxious Vapours in Gilding Metals. The following Communications were received from him, an Explanatory Engraving is annexed, and the Apparatus is preserved in the Society's Repository.*

SIR,

IN consequence of the dreadful effects which have occurred to a friend of mine, from the perniciousness of his business as a water-gilder, I have been led to make a machine to prevent persons from having such disorders. I have had the satisfaction to find that my invention is found to answer, and that it will enable the men to work at the forge double the time they were enabled to do in the old method. In order to have them fairly tried, I have disposed of six of the machines, which are much approved of, and I have orders for several more. I hope the invention will meet with the approbation of the Society.

I am, Sir,
Your obedient humble servant,
RICHARD BRIDGEN.

No. 61, *Broad-Street, Bloomsbury,*
May 7th, 1810.

To C. Taylor, M. D. Sec.

It appeared from the enquiry of the Committee appointed to investigate the merits of Mr. Bridgen's invention, that the great injury which arises to the gilders, is from the noxious fumes of the mercury employed in this kind of gilding, and more especially from the act of rubbing the gilded metal after taking it out of the furnace, which operation the workmen are obliged to repeat frequently, and inhale the vapours of the mercury volatilized by the heat.

That the men are in a considerable degree protected from the injury whilst the work is in the furnace, yet sometimes the fumes are forced down the chimney upon them.

That the quantity of crude mercury collected in one of their chimnies is frequently considerable, and that thirty pound of crude mercury were lately collected in one chimney in Pickett-street where this business was carried on.

That the act of rubbing the hot gilded metal taken from the fire, takes up three or four times more time than during its being in the furnace.

That the price of one of these machines is about one guinea; that it effectually prevents the mercury, or any noxious effluvia, from being inhaled; and that the operator may even stand over lighted rags dipped in brimstone, without suffering any injury, during the time he wears this apparatus.

CERTIFICATES.

A CERTIFICATE from Mr. JOHN M'DORROUGH, Water-gilder, No. 3, Castle-street, Holborn, stated, that Mr. Bridgen's preserver had been tried in his workshop, and that he thinks it particularly useful in large works, to prevent the quicksilver, when in a volatile state, from entering the mouth and nostrils, and injuring the bowels, nerves, and speech of the operator.

Mr. H. WEATHERHEAD, Gilder, No. 54, Dean-street, Soho, certified, that he had made a fair trial of Mr. Bridgen's machine, and thinks it of infinite service.

Mr. REES REES, and Mr. JOSEPH BLACKWELL, No. 4, Middle-court, Charles-street, Long Acre, also stated, that they had tried Mr. Bridgen's invention, and believe that it will fully answer the end designed, namely, the preservation of the health of gilders and other persons exposed to the noxious effluvia from metals; that it is perfectly easy in application, and not in the smallest degree inconvenient to the wearer of it.

Mr. **Peter Brown**, Gilder, No. 5, Charles-court, Strand, certified, that Mr. Bridgen's preserver prevents any injury from quicksilver; that he can work with it eight or nine hours, and leave off as fresh as when he began.

Mr. C. **Johnson**, Gilder, No. 4, Prujean-square, Old Bailey, gave his opinion, that Mr. Bridgen's apparatus completely answers every purpose intended, prevents the steam of quicksilver or aquafortis from entering the mouth and nostrils, and secures the workmen from head-aches, and other inward complaints, to which they are subject; and that he is certain if such apparatus was worn from their first engaging in the business, that gilders would never be hurt.

Description of the Engravings of Mr. Richard Bridgen's Apparatus for Water-gilders. Plate 9, *Figs.* 4 *and* 5.

This apparatus consists of a kind of leather mask or hood, which is fitted to the mouth and nose of the operator, and communicates with a pipe which turns backwards over his head, so that he breathes the air from behind him, which is not supposed to be contaminated by the noxious fumes of the mercury. The mask is shown detached from the head, at fig. 5, where *a* is the pipe, enlarging as it descends to a shape proper to receive and fit the nose, mouth and chin; the edges *b b*, *c c*, are stuffed with some elastic material, which adapts it to the forms of the nose and the cheeks; it is held on by the parts *d d*, which are curved so as to enclose the back of the head, and a string *e*, passing through holes in the ends of the parts *dd*, and being hooked into notches made in a piece of wood fixed on the front of the pipe *a*, draws it tight; the halves *d d*, are also tied together behind by strings, as shewn in fig. 4, and are connected with the front piece by hinges *ff*, fig. 5, so that they will open to take the mask off the head. A flexible tube of oiled silk may, if thought necessary, be tied to the end of the tube *a*, and conveyed to the nearest window, so as to give the workman the pure atmospheric air, if it is thought that the air in the room is tainted by the mercury. It is scarce necessary to observe, that the fitting of the mask to the nose, cheeks, and under the chin, must be carefully done, so as to leave no spaces at which the air can enter; and therefore it must be stuffed to fit the person who intends to wear it. The whole mask is made of leather, and the outside varnished.

The SILVER MEDAL *was this Session voted to Mr.* THOMAS WOOD, *of Great Berkhampstead, Herts, for his Invention to prevent prejudicial effects to persons employed in Pointing Needles. The following Communication was received from him, an Explanatory Engraving is annexed, and a Model of the Apparatus is preserved in the Society's Repository.*

SIR,

I HEREWITH submit to the inspection of the Society instituted for the Encouragement of Arts, &c. a model of an inclosed grindstone, intended to prevent prejudicial effects to the persons employed in pointing needles.

This grindstone is enclosed in a case of wood or metal, and hath a hood wherein a square of glass is inserted, designed to admit light on the articles under operation.

The particular advantages attending a grindstone suspended in this manner, with a hood and a damp cloth, are, that the stream or current of air, formed by the motion of the stone on its axis, is confined by the case under the hood of which it enters, and carries with it the fine particles of steel and sand, which it deposits on the lower part of the inside of the wet cloth, which forms the connection between the sides of the case, by these means rendering the operation of pointing needles less pernicious to the health of the operator. The stone may be worked by hand, by water, or machinery.

I am, Sir,
Most respectfully,
THOMAS WOOD.

Great Berkhampstead, Herts,
January 25, 1811.

To C. TAYLOR, M. D. SEC.

Description of the Engraving of Mr. Thomas Wood's, Improvement in the Grindstones for Pointing Needles. Plate 10, *Fig.* 1.

THE grindstone A is enclosed in a box or case, formed of two circles of wood, one marked B, and another on the opposite side, which cannot be seen in this view; *a a* are two thin iron plates placed so near to the stone, as to be as close to it as possible without touching it; two other plates *b*, support a pane of glass at *c*, which at the same time that it prevents the dust from being thrown over the stone into the air, admits light to that part of the stone where the needles are applied; the remaining space between the edges of the two circular boards B, is filled up by a coarse cloth D, which encompasses about ¾ of the edge of the stone, and is then hooked up to the iron plates *a*, by means of two bent pieces of plate iron, to which the cloth is sewed, one of which is seen at *d*; and these are hooked upon other bent pieces, which form part of the plate *a a*; the cloth is wetted when put on, and will then catch the dust which is produced by the grinding, and when it has accumulated much, by unhooking the cloth it may be shook out, and the cloth being wetted is hooked on again; as the stone wears down the piece of plate iron *e*, situated in a groove formed by the edges of the plate *a*, is slided forwards to follow up the reduced edge of the stone, and other plates are put into the groove after *e*, when they are required; the case B is supported by a cross-bar of the frame in which the stone revolves, and which may be made in this or in any other form; the stone is turned in the usual manner of grinding-mills for needles, by a strap passing round a rigger, fixed on the end of its spindle; but this cannot be seen in this view, it being hidden behind the stone.

The SILVER MEDAL *was this Session voted to Mr.* GEORGE WEBSTER, *Leeds, for his mode of conveying Steam from Boilers. The following Communication was received from him, an Explanatory Engraving is annexed, and a Model of the Apparatus is preserved in the Society's Repository.*

SIR,

IT is with pleasure that I communicate to you the contents of this paper, hoping that this invention will be beneficial to the public; the leading feature of the contrivance is simplicity, and that may possibly be a fair recommendation, at least such it seems to me.

I have just finished a new erection, for my better accommodation in the whitening and stoving of woollen cloths, and having been long annoyed in this business with the steam from the hot water in the pans, I determined if possible to get quit of it; besides I had ample proof in my old building, how injurious the steam was to the timbers of the floors, &c. Permit me to say, that I spent a decent sum of money to no purpose, and was giving up the idea, in despair of its accomplishment, when I hit upon this expedient, which answers my most sanguine desires.

I presume that this easy method of carrying away steam has never yet been in practice, and if once known will be of very considerable utility. In the numerous instances in trades where steam is inconvenient, it offers a ready riddance; to the timber in buildings, and to the furniture in houses, private kitchens, &c. it affords a desired security;

but in many trades, as glue-makers, tallow-chandlers, &c. where the effluvia, united with or without water, is offensive and obnoxious, it must be doubly and trebly valuable; and these cases are more numerous than I can recite or am acquainted with. The evaporating matter needs no longer to be the plague of the workmen, or the nuisance of the neighbourhood.

Hoping that the plan, though simple, and that the object, though not of the first magnitude, will be deemed worthy of the approbation of the Society,

I remain, Sir,

Your most obedient servant,

GEORGE WEBSTER.

Stover, Leeds.

Leeds, April 16, 1810.

To C. Taylor, M. D. Sec.

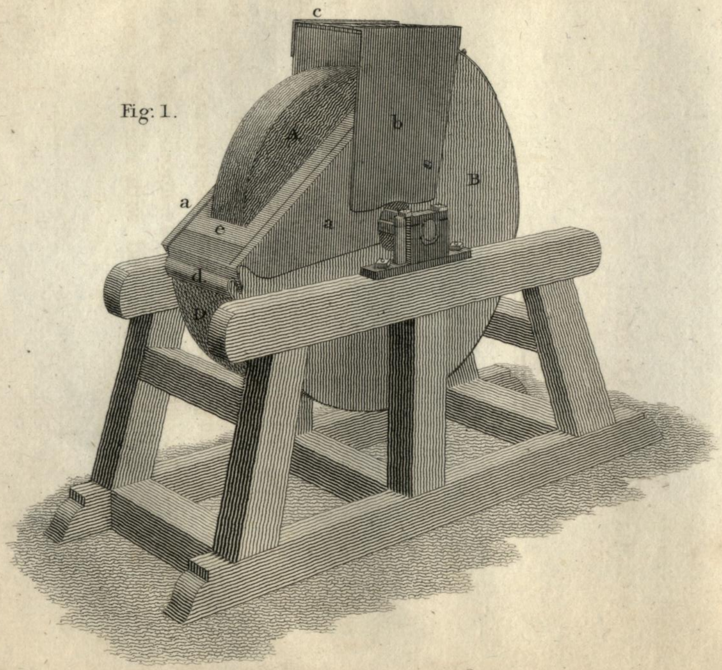
SIR,

In the model I have sent to the Society, the steam chimney is carried up as high as the smoke chimney, which is the case at my works, being my first essay; but this is not immediately necessary, for in the bleach house belonging to Messrs. Benyon, Benyon, and Baze, flax-spinners, of this place, I advised the steam to enter the smoke flue, about six feet above the top of the pan, and with the same good effect.

Several of my friends here have adopted them in their kitchens, Pl. X.

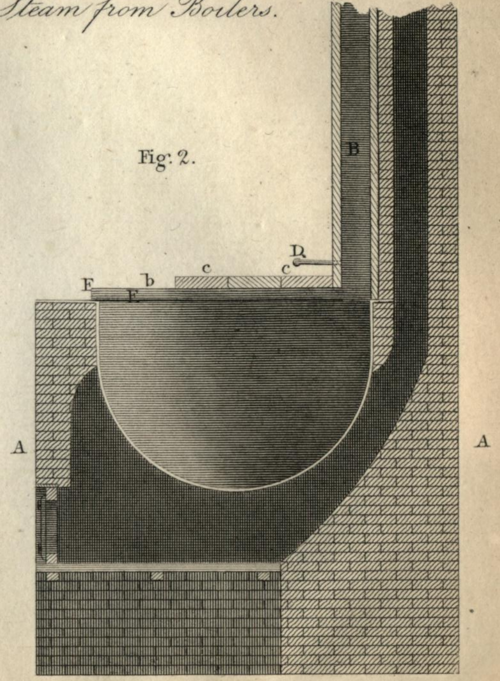
Mr. Wood's Enclosed Grindstone,
for Pointing Needles.

Fig: 1.



Mr. Webster's Method of carrying
off Steam from Boilers.

Fig: 2.



Drawn by J. Farey.

Engraved by S. Porter.

kitchens, and wash and brew-houses. The steam flues are variously curved, as the situations required them to reach the nearest or most convenient smoke chimney, and with the same uniformly good success. I would, however, recommend, that at the lower part of the aperture, where the steam enters a smoke flue, a stone may be made to project a little way into the chimney, in order to break the current of the ascending smoke, and thereby facilitate the entrance of the steam.

I would remark further, that in some cases a curved or angular form may possibly be found the most eligible for the steam chimney, in order to prevent a gust of wind, or any other casualty, from forcing soot down into the liquid in the pan.—I have not yet witnessed any immediate necessity for it myself, and therefore merely suggest it as possible, but yet very easily remedied.

I am, Sir,
Your obedient servant,

GEORGE WEBSTER.

Leeds, May 23, 1811.

To C. TAYLOR, M. D. SEC.

THIS is to certify that we the undersigned have inspected Mr. Webster's contrivance for clearing his room from steam, and conveying it from his pan up what he calls a steam chimney, and found it to answer the desired purpose very effectually.

GEORGE BISCHOFF, Jun. Merchant.
JOHN CAWOOD, Iron-founder.

Reference

Reference to the Engraving of a section of Mr. Webster's Apparatus, for conveying Steam from Boilers, represented in Plate 10, *Fig* 2.

A A, the brickwork surrounding the pan.

B, the steam chimney, made of wood, about two feet broad and six inches deep. A small opening at the back part of the pan admits the steam into this chimney, it may from thence be carried up to the top of the building or turned into any smoke chimney near at hand.

In order to keep the water in the pan as hot as possible during the night, there are two dampers in the steam chimney at D, and if both these dampers are shut, and the whole top of the pan covered closely over at *c*, the boiling water even when the fire is withdrawn, will keep hot for the workmen till the next morning.

C C, are loose boards, fitting close to each other, and covering compleatly the better half of the circle of the top of the pan; and upon this circumstance depends the whole secret of getting quit of the steam. If you remove these boards or partial coverings, the steam chimney loses all its use. The letter *b* shews the part of the top of the pan which should be left open to admit to the workmen a ready communication with the hot water, and through this open part a current of cold air is constantly seen to press and force the steam rapidly up the steam chimney.

It is proper to add, that there must always be an empty space of two or three inches between the surface of the hot water and the under part of the cover *c c*, so as to permit the steam to pass to the bottom of the steam chimney. To effect this purpose, and at the same time to allow the copper to be full of hot water, a rim or curb of wood F, about three inches thick, should be fixed upon the top of the copper, and upon this the covering boards *c c* placed; this allows sufficient room for the steam to press forward to the steam chimney at all times.

The cover and wooden steam chimney are removeable, and may serve for another copper if both are not wanted at the same time.

The SILVER MEDAL and TEN GUINEAS *were this Session voted to Mr.* JOHN PRIOR, *of Nessfield, near Shipton in Craven, for Improvements in the striking part of a Clock. The following Communications were received from him, an Explanatory Engraving is annexed, and a Model of the Improvement is preserved in the Society's Repository.*

SIR,

I WAS engaged to make, some time ago, a clock to go eight days, strike the quarters and hours, and to show minutes and hours upon four faces, on the external part of the steeple of a new church in Kighley, Yorkshire.

The wheel which strikes the quarters and that for the hours, when they came from the foundry, weighed between fifty and sixty pounds of cast brass. The hours are struck in a spiral cut upon a plate screwed to the wheel, like that I had the honour to obtain a bounty for from the Society for the Encouragement of Arts, &c.; and am putting my son's escapement of a pendulum to it, for which he had the like honour.

Sometime in the spring of the last year, I thought if these two wheels could be made without teeth, pins might be put into cast iron as well as brass, and the difference of the prices of those two metals and the workmanship necessary for each, would at least be five guineas less in cast iron than cast brass, for two such wheels as the above, for a large church clock.

In contemplating upon the subject, I invented and had nearly finished in workmanship the last year, the enclosed striking part, but being so near the recess of the Society, I could not finish it in time.

Although there are many detached escapements for clocks and watches, there are not that I know of any detached striking parts, except this, which I have sent for the inspection of the Society for the Encouragement of Arts, &c. which I beg you will lay before them at their first meeting.

My new invented method of striking is easily and expeditiously made, as it lays aside the train of wheels and pinions, which is much better substituted by a small part of a circle, at the end of a lever toothed, which is elevated with the hammer, and may be put out of the frame of the clock turning a fly forwards and backwards. The first motion is to regulate the rapidity with which the hammer would strike, and the latter has nothing to do with the power that struck the hammer, but is acted on by gravity, which will regulate the intervals between the strokes more accurately than any train of wheels and pinions can do with a fly; at the end of which motion it unlocks a detent, which stops against the pins that strike the hammer in the wheel without teeth; and as the elevation of the lever puts forwards the count wheel one tooth, till one of the twelve pins for the use of counting the hours, or the proper number to be struck, comes into the way of the lever, and then prevents it from unlocking the detent, then the clock gives over striking till the next hour.

It is to be remarked, that if this striking part had turned the fly only one way, the same number of turns could not bridle the rapidity of the motion of the hammer, therefore it follows, that the striking part will raise a heavier hammer than any one made to strike with a train of wheels and pinions can do.

I have the honor to be, Sir,

Your much obliged humble servant,

JOHN PRIOR.

P. S. Although the weight of the lever keeps the detent from being locked, it is not necessary it should, for a body in motion requires a great resistance to stop it, as at the end of the back motion of the fly, at which time it unlocks the detent, it has no occasion to be unlocked before, therefore the lever will have more than sufficient power to do that business; if it be made as light again as it is, or more, and whatever weight is taken from the lever may be taken from the first power, and still the striking part will elevate as heavy a hammer as before, and the first power or the weight will be more applied to elevate the hammer, and less to do with that which is substituted as a train of wheels or pinions.

Nessfield, near Skipton in Craven,
Yorkshire, April 10, 1811.

To C. Taylor, M. D. Sec.

Description

Description of Mr. John Prior's new Striking Part of a Clock, Plate 11, Figs. 1, 2, and 3.

In this plate three elevations of this mechanism are given; fig. 1, is a section of the wheels, detents, &c., the front plate of the frame being removed to shew them; fig. 2, is a side view thereof; and fig. 3, shews the count-wheel, which is situated outside of the plate composing the frame; in all these figures the same letters are employed for reference to all the engravings.

The engravings only represent the striking mechanism, detached from the going part of the clock; A, fig. 1, is the barrel for the striking train, with a line *a* wound round it, and by means of a weight constantly giving the barrel a tendency to revolve in the direction of the arrow, and turn the wheel B with it, (this barrel and wheel is omitted in fig. 2, to avoid confusion); the wheel turns a pinion, on the arbor of which is a wheel *c*, containing thirteen pins, which project from its face, and, as it revolves successively, raise the tail *b* (shown by dots in fig. 1,) of the hammer D; when a pin leaves the hammer tail, the spring *d* throws the hammer against the bell E to strike the hour; this is the train of wheel-work for the striking movement; the detents for locking and unlocking these are as follows; a detent *e*, fig. 1, fixed to an arbor *f* extending across the frame, locks the pin-wheel C by receiving one of the pins on its end; the detent is urged into this position by a spring *g*, fig. 2; one of the pivots of the arbor for the hammer is supported in a cock F placed in the center of the space between the plates; the same pivot hole contains one pivot of another arbor *h*, fig. 2, which is therefore in a right line with the arbor of the hammer, and appears in that figure as if in one piece, but in reality has no connection with the hammer, except that a pin, *i*, projecting from the hammer-tail, intercepts another pin fixed into the arbor *h*, so that every time the hammer is thrown back by the pins of the striking wheel raising its tail, the arbor *h* is turned round a small quantity; on this arbor is fixed a long lever K, fig. 1, which has at its extreme end a circular rack of teeth, acting upon a pinion, or an arbor, carrying a fly, such as is always used for the striking movement; the fly is shewn edgeways in fig. 1, at *l*, but is omitted in the other figures to avoid confusion; it is this fly which regulates the time of the strokes; their number is ascertained by a count-wheel shewn at G, in fig. 3; this is placed to turn round on a stud or pin on the outside of one of the plates of the frame; it has seventy-eight ratchet teeth cut in its circumference, and has a detent, H, moving round on the same center pin; this has a piece of watch-spring *m* acting as a click to turn the wheel round when the detent H is lifted up, but when this is let fall its click slips over the teeth of the wheel; *n* is a similar click, but fixed to the frame plate, to prevent the wheel turning backwards; the count-wheel has pins projecting from it on the side next the frame plate, and these are arranged in the same order as the count-wheel always is, the first pair of pins being situated only one tooth distance; the second interval is two teeth, then three, four, and so on, the interval between the pins increasing one tooth each time up to twelve, making in all seventy-eight teeth; these pins are acted upon by an arm *p*, fastened to the rack K, and having a stud at the end which comes through a circular slit or aperture, (shewn in fig. 3,) in the frame plate, and rests upon the pins in the count-wheel at proper intervals.

Operation of the Mechanism.

When the movement is at rest, the pin wheel *c* is locked by the detent *e*; at every hour this is pushed away from the center of the wheel by a pin in that wheel of the going part of the clock, which makes one revolution in an hour; the connection of these parts is not shewn in the drawing, but it may be done in various ways, as by a pin fixed in the detent, and passing through an aperture in the frame plate, or by a lever affixed to the arbor *f*, fig. 2, of the detent; the means will depend on the kind of clock the movement is applied to; all that is required being to push the end of the detent *e* so far from the center of the pin-wheel as to unlock its pins.

The weight now sets the wheels in motion, and the pins lift up the tail of the hammer to strike the hour; as the hammer is thrown back, it raises the rack K, and turns the pinions and fly as before explained, the motion of the pin-wheel and hammer being regulated by this fly, and prevented from accelerating; when the pin leaves the hammer-tail, the hammer, by its spring, strikes the bell, being detached from the neck and fly in its return, as is evident from inspection of fig. 2, by the time the hammer falls, the locking detent being relieved from the going part of the clock, resumes its original position, and prevents the wheel turning any further; the weight of the rack K causes it to descend, and the fly (turning in a contrary direction to what it did before) regulates the period of its descent; when the rack arrives at the position of fig. 1, it strikes a small arm projecting from the arbor *f*, and by this means pushes the locking detent away from the wheel which now sets off again, raising the hammer as before.

This

Mr. John Prior's New Striking Part for a Clock.

Fig: 1.

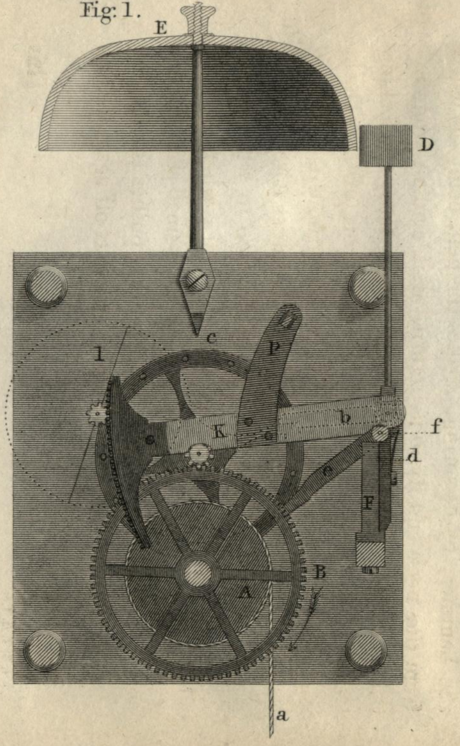


Fig: 2.

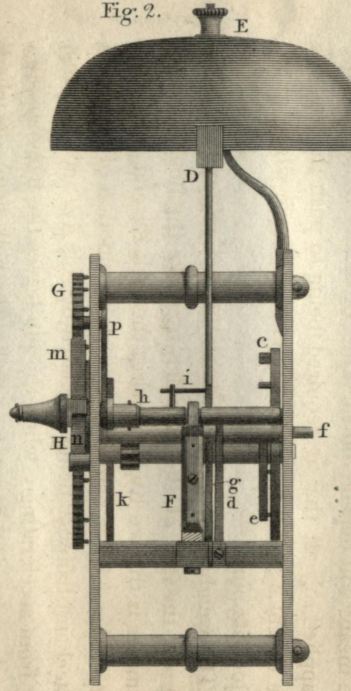
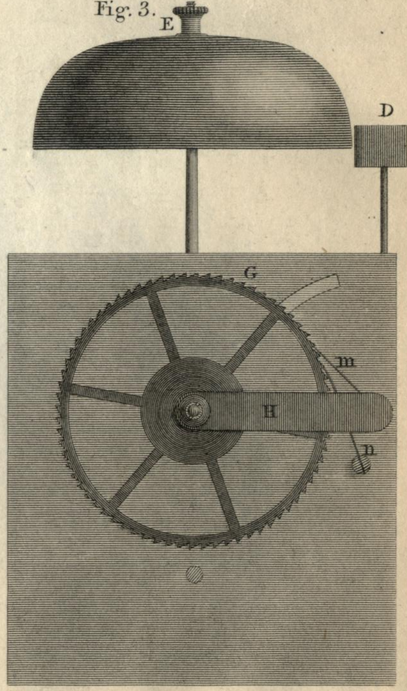


Fig: 3.



Drawn by J. Farey.

Engraved by S. Porter.

This explains the application of the fly to regulate the interval between the strokes; but it remains to mention the means by which the proper number of strokes are made. The rack K has a pin projecting from it, and coming through a hole in the plate, raises up the lever H, which, as before explained, turns the count-wheel G round one tooth at every stroke of the hammer, but after having made the intended number of strokes, one of the pins of the count-wheel comes into such a position that the arm *p* of the rack rests upon it, and prevents the rack descending low enough to reach the arm of the detent *e*; the wheel is now locked, and must wait the expiration of another hour before it resumes its action, by the locking detent being moved by the going part of the clock; but when one stroke is made, the count-wheel being turned round one tooth, the pin is removed from the arm of the rack, and the striking continues till another pin is brought under it: the number of strokes the hammer will make therefore depends on the spaces between the pins in the count-wheel, and these are arranged as before mentioned, and as is well known to all clockmakers.